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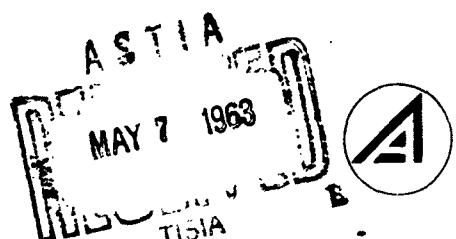
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Quasi-Static Aero-Thermo-Elastic Analysis: Analytical Development and Computational Procedure

1 MARCH 1963

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UNITED STATES AIR FORCE
Inglewood, California



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ABSTRACT

A collocation formulation is used as the basis for a unified approach to the various quasi-static aero-thermo-elastic problems. These problems include rigid and flexible load distributions, divergence, estimation of rigid and flexible static and dynamic stability derivatives, and the correction of wind tunnel data measured on flexible models. The formulation utilizes structural, thermal, and aerodynamic influence coefficients.

The Aerospace IBM 7090 Computer Program No. LD003A provides the solution to the above problems. The program capacity is fifty collocation control points and ten values of dynamic pressure.

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SYMBOLS

a	Element of flexibility matrix
a_T	Element of thermal influence coefficient matrix
b_r	Reference semichord
C_h	Element of oscillatory aerodynamic influence coefficient matrix
C_{hs}	Element of steady aerodynamic influence coefficient matrix
C_l	Aerodynamic rolling moment coefficient
C_m	Aerodynamic pitching moment coefficient
C_z	Aerodynamic normal force coefficient
C_z	Element of aerodynamic normal force coefficient distribution matrix
$C_z^{(e)}$	Element of experimentally determined aerodynamic normal force coefficient distribution matrix
c	Local chord
\bar{c}	Mean aerodynamic chord
\tilde{c}	Average chord
c_l	Local spanwise lift coefficient
F	Element of force matrix
H	Generalized reference deflection
H_o	Reference deflection for initial deflection mode
h	Element of deflection matrix
I	Element of unit matrix
K	Flexibility matrix normalizing constant
k_r	Reference reduced frequency

ζ	Rolling moment
M	Element of mass matrix; bending moment
m	Pitching moment
N	Reference load factor
n	Element of load factor matrix
q	Dynamic pressure
q_{div}	Divergence dynamic pressure
S	Surface reference area
s	Surface span measured from root to tip
T	Reference temperature; torque
t	Element of temperature distribution matrix
V	Shear
W	Element of aerodynamic weighting matrix
x, y	Cartesian coordinates
\bar{x}, \bar{y}	Coordinates of aerodynamic center
x_o	Coordinate of pitching moment reference axis
Z	Normal force
$\Delta()$	Denotes incremental value
θ	Angle of pitch
λ	Eigenvalue
ξ	Control point location as fraction of local chord
ρ	Atmospheric density
ω	Frequency

(

Subscripts

a	Aerodynamic
f	Flexible
H, T, N	As subscript to C_Z , C_m , and C_l , denotes partial differentiation with respect to H, T, or N, respectively, e.g., $C_{ZH} = \partial C_Z / \partial H$; as subscript to C_Z , merely denotes reference to H, T, or N
i	Inertial; also used as dummy index, e.g., Δy_i denotes width of <u>i</u> th strip
m	Model; moment
o	Initial value
r	Rigid

Matrices

[]	Square
{ }	Column
[]	Row
[] ⁻¹	Inverse
[]	Diagonal

}

SECTION I

FORMULATION OF PROBLEM

A. Introduction

The most general numerical formulation that can be made of the various aeroelastic problems is a collocation formulation expressed in terms of matrices of structural, inertial, and aerodynamic influence coefficients. Such a formulation of the flutter problem has been discussed in Ref. 1, and of the static aeroelastic problems in Ref. 2. The present report reconsiders the static aeroelastic problems by reviewing the derivations and extending the computational procedures of Ref. 2 in treating the problems of rigid and flexible load distributions, divergence, estimation of rigid and flexible static and dynamic stability derivatives, and correction of wind tunnel data measured on flexible models.

The basis for the present generalized aero-thermo-elastic analysis is found in recent advances in both aerodynamic and structural theories. The aerodynamic developments have proffered aerodynamic influence coefficients based on a number of theories, covering the entire Mach number range of current interest. The structural developments have provided structural and thermal influence coefficients for external and temperature loadings, respectively, for surfaces of arbitrary aspect ratio. The current state of the art of aerodynamic and structural influence coefficient analyses is surveyed in Refs. 3 and 4, respectively.

B. Sign Convention

We choose the NASA body stability axis system as our coordinate system: x forward, y starboard, and z down. Positive loads and deflections are in the same directions, and positive moments are given by applying the right-hand rule to the coordinate directions.

C. Derivation of Equations

The force distribution $\{F\}$ acting on a flexible lifting surface or body arises from two sources: the aerodynamic forces resulting from the attitude (as specified by the deflection mode $\{h\}$), and the inertial forces resulting from a distribution of load factor $\{n\}$. The aerodynamic forces are found from the weighted (the weighting matrix must be derived from experimental data on the force changes resulting from changes in attitude; see Refs. 5 and 6) steady aerodynamic influence coefficients (AICs), and/or a set of experimentally determined control point force coefficients

$$\{F_a\} = (qS/\bar{c})[W][C_{hs}] \{h\} + qS \{C_{zr}^{(e)}\} \quad (1)$$

The use of the experimental force coefficients is generally necessary to account for the aeroelastic behavior arising from camber and/or wing-body interference. The inertial forces are found from the mass matrix

$$\{F_i\} = [M] \{n\} \quad (2)$$

The total force distribution therefore becomes

$$\{F\} = \{F_a\} + \{F_i\} \quad (3a)$$

$$= (qS/\bar{c})[W][C_{hs}] \{h\} + qS \{C_{zr}^{(e)}\} + [M] \{n\} \quad (3b)$$

The deflection mode $\{h\}$ is composed of the initial deflection mode of the rigid surface $\{h_r\}$ * the thermal distortion mode (which may be considered to be initially built in) which is found from the incremental temperature distribution and the matrix of thermal influence coefficients (TICs), and the deformation mode of the flexible surface $\{h_f\}$

$$\{h\} = \{h_r\} + [a_T]\{t\} + \{h_f\} \quad . \quad (4)$$

The deformation mode of the flexible surface is found from the total force distribution and the matrix of structural influence coefficients (SICs)

$$\{h_f\} = K[a] \{F\} \quad , \quad (5)$$

where K is a normalizing factor to the SICs (introduced for convenience in studying variations in stiffness levels). Combining Eqs. (3b), (4), and (5) permits the solution for the deformation mode

$$\{h_f\} = K[A][a] \{F_r\} \quad , \quad (6)$$

where $\{F_r\}$ is the force distribution on the rigid system (again considering the thermal distortion to be initially built in).

$$\{F_r\} = (qS/\bar{c})[W][C_{hs}] (\{h_r\} + [a_T]\{t\}) + qS\{C_{zr}^{(e)}\} + [M]\{n\} \quad , \quad (7)$$

* A distinction is made later in the derivation [see discussion preceding Eq. (31)] between two sources of the initial deflection mode: that arising from any built-in twist or camber and that arising from the attitude (sometimes called the additional deflection mode). The program computes the initial deflection mode as the sum of these, $\{h_r\} = H_0\{h_r/H_0\} + H\{h/H\}$, and both sets of data are required. The distinction is not made at this point because it is not essential to the derivation.

where

$$[A] = ([I] - (KqS/\bar{c})[a][W][C_{hs}])^{-1} \quad (8)$$

The total force distribution is found by returning to Eq. (3b) with Eqs. (4) and (6)

$$\{F\} = [B]\{F_r\} \quad (9)$$

where

$$[B] = [I] + (KqS/\bar{c})[W][C_{hs}][A][a] \quad (10)$$

For the purpose of structural analysis, it is often convenient to convert the control point forces into the structural loads of shear, moment and torque at particular stations. A set of transformation matrices may be defined to compute

the shear

$$\{V\} = [V/F]\{F\} \quad (11)$$

the moment

$$\{M\} = [M/F]\{F\} \quad (12)$$

and the torque

$$\{T\} = [T/F]\{F\} \quad (13)$$

Each element in the load coefficient matrices is the load at a particular station due to a unit control point force.

In certain longitudinal problems, it is desirable to adjust the attitude so that the flexible system sustains a specified total aerodynamic force. If we denote the specified total by Z , then

$$[I] \left(\{F\} - [M]\{n\} \right) = Z \quad (14)$$

and if we extend the definition of $\{h_r\}$ in Eq. (4) to include the change in pitch attitude, we have

$$\{h_r\} = \{h_{r_0}\} - \Delta\theta\{x\} \quad (15)$$

The substitution of Eqs. (7), (9), and (15) into Eq. (14) leads to the solution for the incremental pitch angle

$$\Delta\theta = (1/D)(C - Z) \quad (16)$$

where

$$C = [I] \left([B]\{F_{r_0}\} - [M]\{n\} \right) \quad (17)$$

$$D = (qS/\bar{c})[I][B][W][C_{hs}]\{x\} \quad (18)$$

and

$$\{F_{r_0}\} = (qS/\bar{c})[W][C_{hs}] \left(\{h_{r_0}\} + [a_T]\{t\} \right) + qS\{C_{zr}^{(e)}\} + [M]\{n\} \quad (19)$$

The final force distribution in this case follows from Eqs. (7), (9), (15), and (19)

$$\{F\} = [B]\{Fr_o\} - \Delta\theta(qS/\bar{c})[B][W][Ch_s]\{x\} \quad (20)$$

The final deflection mode follows from Eqs. (4), (5), (15), and (20)

$$\{h\} = \{hr_o\} - \Delta\theta\{x\} + K[a]\{F\} + [a_T]\{t\} \quad (21)$$

A variation of the foregoing is found in maintaining a constant total force equal to that given by the rigid condition (without the thermal distortion). In this case

$$Z = qS[I] \left((1/\bar{c})[W][Ch_s]\{hr_o\} + \{C_{zr}^{(e)}\} \right) , \quad (22)$$

and Eqs. (16), (17), (18), (20), and (21) provide the solution for the final force distribution and deflection mode.

The possibility of divergence is seen in Eq. (6) as the inverse of the matrix [A] approaches singularity. The critical values of (Kqs/\bar{c}) that yield a singularity are related to the eigenvalues of the matrix, and the divergence condition is specified by the eigenvalues of the equation

$$\lambda\{h_f\} = [a][W][Ch_s]\{h_f\} , \quad (23)$$

where

$$\lambda = \bar{c}/KSq_{div} , \quad (24)$$

from which the divergence dynamic pressure is found

$$q_{div} = \bar{c}/\lambda KS \quad (25)$$

Any positive value of q_{div} shows a divergence possibility although usually only the first or second values have any practical significance. The corresponding eigenvectors of Eq. (23) are the divergence modes.

The foregoing development of the force distribution on the flexible system provides the basis for estimating aerodynamic stability derivatives. The aerodynamic coefficients are defined by the following:

$$C_Z = Z/qS \quad (26a)$$

$$= (1/qS)[I] (\{F\} - [M]\{n\}) \quad (26b)$$

$$C_m = M/qS\bar{c} \quad (27a)$$

$$= -(1/qS\bar{c})[x - x_o] (\{F\} - [M]\{n\}) \quad (27b)$$

$$C_l = L/qSs \quad (28a)$$

$$= (1/qSs)[y] (\{F\} - [M]\{n\}) \quad (28b)$$

The center of pressure is found from

$$(\bar{x} - x_o)/\bar{c} = -M/Z \quad (29a)$$

$$= -C_m/C_Z \quad (29b)$$

$$y/s = L/Z \quad (30a)$$

$$= C_l/C_Z \quad (30b)$$

The force distribution for use in the above equations is found from Eqs. (7) and (9). To derive the stability derivatives, it is convenient to define a reference generalized deflection H , a reference temperature change T , and a reference load factor N . It is further convenient to consider an initial deflection mode $\{h_r\} = H_0\{h_r/H_0\}$ where H_0 is a reference initial deflection as distinct from that caused by the attitude change (additional deflection) specified by H . * These modifications permit Eq. (7) to be rewritten in a more general form

$$\begin{aligned}\{F_r\} = qS & \left(\{C_{zr}^{(e)}\} + (1/\bar{c})[W][C_{hs}] \left(H_0\{h_r/H_0\} \right. \right. \\ & \left. \left. + H\{h/H\} + T[a_T]\{t/T\} \right) \right) + N[M]\{n/N\} \quad (31)\end{aligned}$$

The initial coefficients and the stability derivatives are defined by

$$C_Z = C_{Z_0} + C_{ZH}H + C_{ZT}T + C_{ZN}N \quad (32)$$

$$C_m = C_{m_0} + C_{mH}H + C_{mT}T + C_{mN}N \quad (33)$$

$$C_l = C_{l_0} + C_{lH}H + C_{lT}T + C_{lN}N \quad (34)$$

where C_{ZH} , C_{ZT} , and C_{ZN} are examples of aerodynamic, thermal and inertial derivatives, respectively. The substitutions of Eqs. (9) and (31) into Eqs. (26b), (27b), and (28b) and a comparison with the coefficients of H , T , and N in Eqs. (32) through (34) yields the following. The initial

* See footnote, p. 3.

coefficients are

$$C_{Z_o} = [I][B] \{C_{z_r}\} \quad (35)$$

$$C_{m_o} = -(1/\bar{c})[x - x_o][B] \{C_{z_r}\} \quad (36)$$

$$C_{l_o} = (1/s)[y][B]\{C_{z_r}\} \quad (37)$$

where

$$\{C_{z_r}\} = \{C_{z_r}^{(e)}\} + (H_o/\bar{c})[W][C_{h_s}]\{h_r/H_o\} \quad (38)$$

The aerodynamic stability derivatives are

$$C_{Z_H} = [I][B] \{C_{z_{Hr}}\} \quad (39)$$

$$C_{m_H} = -(1/\bar{c})[x - x_o][B] \{C_{z_{Hr}}\} \quad (40)$$

$$C_{l_H} = (1/s)[y][B]\{C_{z_{Hr}}\} \quad (41)$$

where

$$\{C_{z_{Hr}}\} = (1/\bar{c})[W][C_{h_s}]\{h/H\} \quad (42)$$

The thermal derivatives are

$$C_{Z_T} = [I][B] \{C_{z_T}\} \quad (43)$$

$$C_{m_T} = -(1/\bar{c})[x - x_o][B]\{C_{z_T}\} \quad (44)$$

$$C_l_T = (1/s)[y][B]\{C_{z_T}\} \quad (45)$$

where

$$\{C_{z_T}\} = (1/\bar{c})[W][C_{hs}][a_T]\{t/T\} \quad (46)$$

Finally, the inertial derivatives are

$$C_{Z_N} = [I]\{C_{z_N}\} \quad (47)$$

$$C_{m_N} = -(1/\bar{c})[x - x_o]\{C_{z_N}\} \quad (48)$$

$$C_l_N = (1/s)[y]\{C_{z_N}\} \quad (49)$$

where

$$\{C_{z_N}\} = (K/\bar{c})[W][C_{hs}][A][a][M]\{n/N\} \quad (50)$$

The center of pressure for each of these loadings is found from Eqs. (29b) and (30b) using the appropriate coefficients or derivatives.

The rigid aerodynamic stability derivatives may be estimated from Eqs. (39) through (42) by taking $[B] = [I]$ (i.e., $q = 0$). Equations (39) through (42) may also be used to estimate dynamic stability derivatives by using the (complex) oscillatory AICs which are defined by

$$\{F\} = \rho \omega^2 b_r^2 s [W][C_h]\{h\} \quad (51)$$

By comparing this definition to the steady definition of Eq. (1), we see it is only necessary to replace $[C_{hs}]$ by $2k_r^2(\bar{c}s/S)[C_h]$ and to permit $\{h/H\}$ to become complex in order to make all of the preceding development applicable to the oscillatory case. Since this is a significant feature of the present analysis, we digress to illustrate the calculation in some detail. We choose as an example the estimation of the symmetrical longitudinal stability derivatives. We begin with the general expressions for the lift and moment coefficients for transient longitudinal motion.

$$C_Z = C_{Z_a} a + C_{Z_{Da}} (\dot{a}\bar{c}/2V) + C_{Z_q} (\dot{\theta}\bar{c}/2V) \\ + C_{Z_{D^2a}} (\ddot{a}\bar{c}^2/4V^2) + C_{Z_{Dq}} (\ddot{\theta}\bar{c}^2/4V^2) + \dots \quad (52)$$

$$C_m = C_{m_a} a + C_{m_{Da}} (\dot{a}\bar{c}/2V) + C_{m_q} (\dot{\theta}\bar{c}/2V) \\ + C_{m_{D^2a}} (\ddot{a}\bar{c}^2/4V^2) + C_{m_{Dq}} (\ddot{\theta}\bar{c}^2/4V^2) + \dots \quad (53)$$

If we truncate the series at the points shown in Eqs. (52) and (53), and consider the case of harmonic pitching ($\theta = a$) with amplitude a_0 , then

$$C_Z = a_0 \left[C_{Z_a} + ik \left(C_{Z_{Da}} + C_{Z_q} \right) - k^2 \left(C_{Z_{D^2a}} + C_{Z_{Dq}} \right) \right] \quad (54)$$

$$C_m = a_0 \left[C_{m_a} + ik \left(C_{m_{Da}} + C_{m_q} \right) - k^2 \left(C_{m_{D^2a}} + C_{m_{Dq}} \right) \right] \quad (55)$$

where the reduced frequency $k = \omega/\bar{c}/2V$. In the case of harmonic plunging ($\theta = 0$, $a = h/V$) with amplitude h_o , then

$$C_Z = h_o(2/\bar{c}) \left[ikC_{Z_a} - k^2 C_{Z_{Da}} - ik^3 C_{Z_{D2a}} \right] \quad (56)$$

$$C_m = h_o(2/\bar{c}) \left[ikC_{m_a} - k^2 C_{m_{Da}} - ik^3 C_{m_{D2a}} \right] \quad (57)$$

The lift and moment coefficients can also be found from Eqs. (39), (40), and (42) by making the substitutions noted above (i. e., $[B] = [I]$, and replacing $[C_{hs}]$ by $2k_r^2(\bar{c}s/S)[C_h]$).

$$C_Z = H[I] \{C_{z_{Hr}}\} \quad (58)$$

$$C_m = -H(1/\bar{c})[x - x_o] \{C_{z_{Hr}}\} \quad (59)$$

where

$$\{C_{z_{Hr}}\} = 2k_r^2(s/S)[W][C_h]\{h/H\} \quad (60)$$

To appraise the various longitudinal derivatives it is necessary to evaluate Eqs. (58) through (60) for both motions, pitching and plunging. For pitching about station x_1 , the reference deflection is taken as $H = a_o$, and the additional deflection mode is $\{h/H\} = \{x_1 - x\}$; for plunging, the reference deflection is $H = h_o$, and the additional deflection mode is $\{h/H\} = \{I\}$. The computational sequence is now evident. The evaluation of Eqs. (58) and (59) for the plunging motion yields two complex numbers which, when identified with the real and imaginary parts of Eqs. (56) and (57), lead to the four derivatives $C_{Z_{Da}}$, $C_{m_{Da}}$, $C_{Z_{D2a}}$, and $C_{m_{D2a}}$ (assuming, of course, that the static stability derivatives C_{Z_a} and C_{m_a} have already been determined).

A similar evaluation of Eqs. (58) and (59) for the pitching motion yields another set of two complex numbers which, when identified with the real and imaginary parts of Eqs. (54) and (55), and with appropriate utilization of the angle of attack derivatives determined previously, lead to the remaining derivatives C_{Zq} , C_{mq} , C_{ZDq} , and C_{mDq} . In a similar manner, many of the lateral-directional dynamic stability derivatives can be found from oscillatory AICs.

Our treatment of the stability derivatives provides a means of estimating a dimensionless spanwise load distribution and the spanwise variation of the chordwise center of pressure on a lifting surface. This calculation requires the data on which the AICs are based, i. e., the location and number of the chordwise control points, and the widths of the strips into which the surface has been divided. The load distribution coefficients are needed to make these calculations. The flexible load distribution coefficients are given by

$$\{C_{zf}\} = [B]\{C_z\} \quad , \quad (61)$$

where $\{C_z\}$ denotes any of the various distributions for the different loads except for the inertial loads; i. e., $\{C_z\}$ can be taken to represent any of $\{C_{zr}\}$, $\{C_{zHr}\}$, or $\{C_{zT}\}$; in the inertial case, $\{C_{zN}\}$ is used directly, i. e., $\{C_{zf}\} = \{C_{zN}\}$. The elements of $\{C_{zf}\}$ are listed in order for each surface strip as derived in the AICs and can be used to find the local dimensionless loading and center of pressure. Let us denote the sum of the load coefficients on the ith strip by

$$\Delta C_{Z_i} = \sum_{\text{strip } i} C_{zf} \quad (62)$$

and the moment about the leading edge by

$$\Delta C_{m_i} = \sum_{\text{strip } i} \xi C_{zf} \quad , \quad (63)$$

where ξ is the dimensionless chordwise location of each control point aft of the leading edge. Then the spanwise loading on the i th strip is given by

$$(c_f c / \bar{c})_i = -\Delta C_{Z_i} (s / \Delta y_i) \quad (64)$$

where Δy_i is the load strip width. The local center of pressure is given by

$$\xi_i = \Delta C_{m_i} / \Delta C_{Z_i} \quad (65)$$

The problem of reducing wind tunnel data is our last consideration. The purpose of a wind tunnel test is the measurement of the so-called rigid loads on the configuration (unless the model is specifically designed for aeroelastic measurements). But since no model is completely rigid, some aeroelastic correction can be made to any wind tunnel measurement. We now consider this correction. The situation is described by Eq. (61), which may be written as

$$\{C_{Z_f}^{(e)}\} = [B_m] \{C_{Z_r}^{(e)}\} \quad (66)$$

where $\{C_{Z_f}^{(e)}\}$ is the set of force coefficients measured on the flexible model, $[B_m]$ is the aeroelastic amplification matrix based on the model properties from Eq. (10), and $\{C_{Z_r}^{(e)}\}$ is the set of desired force coefficients on the rigid configuration. Obviously the rigid force coefficients follow from the inverse of Eq. (66)

$$\{C_{Z_r}^{(e)}\} = [B_m]^{-1} \{C_{Z_f}^{(e)}\} \quad (67)$$

The rigid force coefficients so determined then provide the starting point for the aeroelastic analysis of the prototype.

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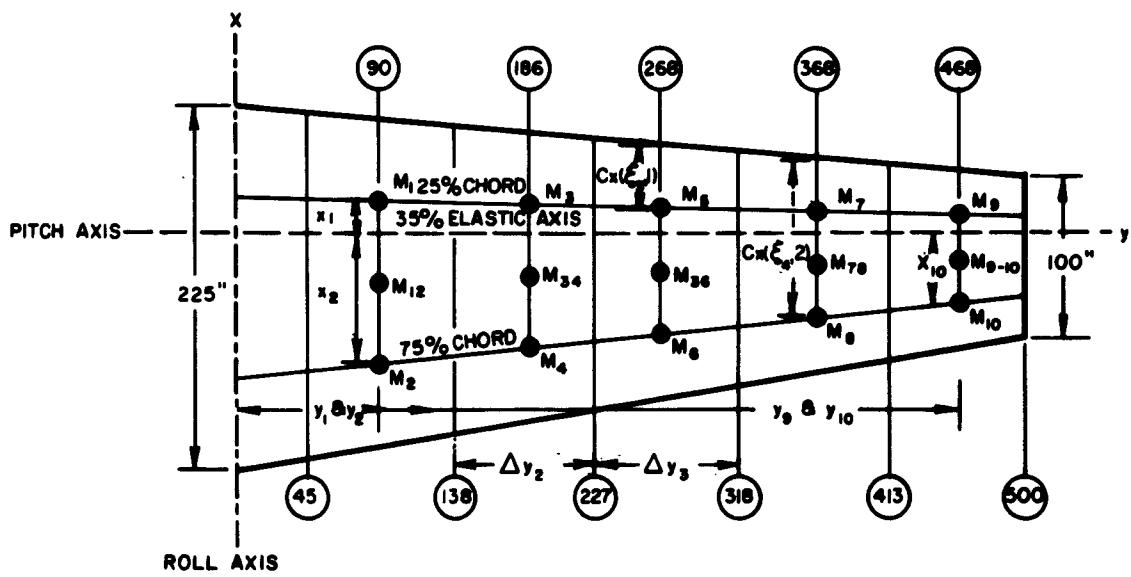


Fig. 1. Jet transport wing geometry.

SECTION II

GENERAL DESCRIPTION OF INPUT

A. Units

All units are taken in the pound-inch system with two exceptions: the surface area is in square feet, and the dynamic pressure is in pounds per square foot.

B. Example Problem

We consider the static aeroelastic analysis of the five strip wing whose geometry is shown in Fig. 1. This is the jet transport wing analyzed by Bisplinghoff, Ashley, and Halfman throughout Ref. 7. We will use the following program options: trimmed loads with the structural loads suboption, divergence, aerodynamic stability derivatives (due to angle of attack), and inertial derivatives (due to symmetrical load factor). We proceed to assemble the data required as input to the program when it is to perform these options. The flexibility, mass, and aerodynamic influence coefficient matrices (all size 10×10) are printed in the program output example (pp. 45 through 48) and need not be shown here. The flexibility and mass matrices are taken from Ref. 1; the aerodynamic influence coefficients are developed from the subsonic lifting surface method of Ref. 8 at a Mach number of zero. We shall list only the additional data needed for the representative options. A basic list of constants can be used for all of the options and is given below:

$$c = 225 \text{ inches}$$

$$K = 1.0 \times 10^{-7}$$

$$S = 564.236 \text{ square feet}$$

$$Z = -41,919 \text{ pounds (this is the lift on one wing required in level flight neglecting any tail load or fuselage lift, and taking one-half the fuselage weight as 17,400 pounds)}$$

$$H = 1.0$$

$T = 0$
 $N = 1.0$
 $s = 500 \text{ inches}$
 $x_o = 0$
 $H_o = 0$

For the loads option we make the following assumptions: the aircraft is to be trimmed at three values of dynamic pressure: $q = 400, 800, \text{ and } 1200 \text{ psf}$; the aerodynamic matrix needs no experimental correction (the weighting matrix is taken as unity); no lift has been derived experimentally ($\{C_{z_r}^{(e)}\} = \{0\}$, size 10×1); there is no initial deflection mode ($\{h_r/H_o\} = \{0\}$, size 10×1); the additional deflection mode corresponds to zero angle of attack ($\{h/H\} = \{0\}$, size 10×1); and the symmetrical load factor distribution matrix is a unit column ($\{n/N\} = \{1\}$, size 10×1). The control point chordwise coordinate matrix for use in the trim analysis is

$$\{x\} = \begin{Bmatrix} 20.25 \\ -81.00 \\ 17.85 \\ -71.40 \\ 15.80 \\ -63.20 \\ 13.30 \\ -53.20 \\ 11.05 \\ -44.20 \end{Bmatrix} \text{ (inches)}$$

measured from the (unswept) 35 percent chord line as shown in Fig. 1. The final data necessary to compute the structural loads are the shear, moment, and torque coefficient matrices. Considering only the loads at the side of the fuselage, we have

$$[V/F] = [I], \text{ size } 1 \times 10,$$

$$[M/F] = [45 45 141 141 223 223 323 323 413 413],$$

$$[T/F] = [-20.25 +81.00 -17.85 +71.40 -15.80 +63.20 -13.30 +53.20 -11.05 +44.20].$$

The divergence option may be run simultaneously with the loads option since it requires only a portion of the above information. We request two divergence modes and dynamic pressures to be found.

The aerodynamic derivatives options will be carried out for the rigid case ($q = 0$) in addition to the previous list of dynamic pressures. The additional deflection mode $\{h/H\}$ used in the aerodynamic stability derivatives will be based on a one-radian angle of attack mode and is found from

$$\{h/H\} = -\{x/57.296\} = \begin{pmatrix} -0.35343 \\ 1.41371 \\ -0.31154 \\ 1.24616 \\ -0.27576 \\ 1.10304 \\ -0.23213 \\ 0.92851 \\ -0.19286 \\ 0.77143 \end{pmatrix} \text{ (per degree)}$$

The calculation of the load distribution and the rolling moment coefficient requires the following additional data shown in Fig. 1: the spanwise coordinate matrix

$$[y] = [90 90 186 186 268 268 368 368 458 458] \text{ (inches),}$$

and the width of each strip and the dimensionless chordwise location of each control point on the strip.

<u>Strip No.</u>	<u>Δy</u>	<u>ξ_f</u>	<u>ξ_a</u>
1	93	0.25	0.75
2	89	0.25	0.75
3	91	0.25	0.75
4	95	0.25	0.75
5	87	0.25	0.75

It is possible to perform all or any selected number of program options with one input deck if all data are real, although, in the example problem taking $\{h/H\} = \{0\}$ in the loads option does not permit calculation of the aerodynamic stability derivatives and taking $q = 0$ in the stability derivative option (to find derivatives for a rigid system) is not compatible with the trimmed loads option which requires $q > 0$. To avoid computing irrelevant results, we use two data decks, reproducing the cards (data) in the first deck that can be used as a part of the second deck.

C. Program Restrictions and Options

1. Maximum matrix size is 50×50 .
2. Maximum number of dynamic pressures per deck is 10.
3. Provision has been made to reserve a partition in the upper left-hand corner of the total AIC matrix for control points (and the flexibility and mass matrices must be compatible with this order of control points) whose aerodynamic forces may be neglected or found from an alternate theory to that used for the primary control points. This partition is termed the "external store" region since external stores are an example of a source of additional control points requiring such special consideration. The maximum number of control points that can be reserved for external stores is 49.
4. Maximum number of modes to be evaluated for the divergence option is 25.
5. For real and complex derivative calculations, the maximum number of strips is 20; the maximum number of control points per strip is 10.
6. Multiple options may be performed with one deck except for the following restrictions:
 - a. The structural loads option must be used as a suboption to the other loads options.

b. In any one input deck, all data must be for steady case (real) options or all data must be for oscillatory case (complex) options.

c. The divergence option cannot be used in the complex case.

7. Only one matrix of associated aerodynamic influence coefficients may be included in any one deck. When external stores are present, the matrix includes the AICs for the stores; however, this area may be set to zero.

8. In the oscillatory case, the following data must be input in complex form: AIC matrix, temperature mode, experimental forces, initial deflection mode, additional deflection modes, and load factor mode.

9. Program options and significant equation numbers as assigned in Part C, Section I are listed below.

- a. Loads for constant root angle of attack; Eqs. (31) and (9).
- b. Loads for trimmed condition; Eqs. (31) and (20).
- c. Loads for constant lift coefficient; Eqs. (22), (31), and (20).
- d. Divergence, Eq. (23).
- e. Initial coefficients; Eqs. (35) through (37).
- f. Aerodynamic stability derivatives; Eqs. (39) through (41).
- g. Thermal derivatives; Eqs. (43) through (45).
- h. Inertial derivatives; Eqs. (47) through (49).
- i. Experimental data reduction; Eq. (67).
- j. Structural loads; Eqs. (11) through (13).

SECTION III

DATA DECK SETUP

A. Loading Order

Data decks are loaded behind column binary deck LD003A. There are nineteen items that can be used in the data deck. The deck is set up with the items entered in the following order:

1. Heading card
2. Data deck control card
3. Constants cards
4. Dynamic pressure card(s)
5. Flexibility matrix
6. Aerodynamic matrix
7. Weighting matrix
8. Thermal matrix
9. Temperature mode
10. Experimental force column
11. Initial deflection mode
12. Additional deflection mode
13. Mass matrix
14. Load factor column
15. Chordwise coordinates
16. Spanwise coordinates
17. Strip widths and control point locations (percent chord)

18. Load coefficient matrices (shear, moment, torque)

19. Second and successive "additional deflection mode" columns

Items 1, 2, 3, and 6 must be present in all data decks; the presence (or absence) of the other items is determined by the option and data indicators used in the data deck control card (Item 2).

B. Input Data Description

1. The heading card may contain any alphanumeric characters desired in Columns 2 through 80. It is normally used for job title, engineer's name, and data.

2. Data deck control card (FORMAT 18I4): This card specifies which options are to be performed and also indicates the presence of certain data. The eighteen fields of this card are used as follows:

Field 1. Column 4 contains a 1 if load option 1 (LOADS FOR CONSTANT ROOT ANGLE OF ATTACK) is to be performed; it contains a zero or blank if not to be performed.

Field 2. Column 8 contains a 1 if load option 2 (LOADS FOR TRIMMED CONDITION) is to be performed, a zero or blank if not.

Field 3. Column 12 contains a 1 if load option 3 (LOADS FOR CONSTANT LIFT COEFFICIENT) is to be performed, a zero or blank if not.

Field 4. Column 16 contains the number of modes (25 maximum) of the DIVERGENCE option to be performed, a zero or blank if not.

Field 5. Column 20 contains a 1 if the INITIAL COEFFICIENTS option is to be performed, a zero or blank if not.

Field 6. Columns 23 and 24 contain the number of solutions for AERODYNAMIC STABILITY DERIVATIVES desired. This option permits varying the "additional deflection mode" $\{h/H\}$ when the other data are unchanged. The first mode is included as Data Item 12, and the second and successive modes are included as Data Item(s) 19.

Field 7. Column 28 contains a 1 if the problem is complex, a zero or blank if all data are real.

Field 8. Column 32 contains a 1 if the THERMAL STABILITY DERIVATIVES option is to be performed, a zero or blank if not.

Field 9. Column 36 contains a 1 if the INERTIAL DERIVATIVES option is to be performed, a zero or blank if not.

Field 10. Column 40 contains a 1 if a weighting matrix is included in the data deck, a zero or blank if excluded.

Field 11. Column 44 contains a 1 if a thermal matrix and associated temperature mode are included in the data deck, a zero or blank if excluded.

Field 12. Column 48 contains a 1 if an experimental force column matrix is included in the data deck, a zero or blank if excluded.

Field 13. Columns 51 and 52 contain the number of elements (control points) reserved for external stores, a zero or blank if none is reserved.

Field 14. Columns 55 and 56 contain the number of dynamic pressures (10 maximum) for which cycling options (repeated for each "q") are to be performed.

Field 15. Column 60 contains a 1 if the EXPERIMENTAL DATA REDUCTION option is to be performed, a zero or blank if not.

Field 16. Column 64 contains a 1 if the STRUCTURAL LOADS option is to be performed, a zero or blank if not.

Field 17. Columns 67 and 68 indicate the order of the system contained in the data deck (50 maximum).

Field 18. Column 72 contains a 1 if the flexibility matrix is present in the data deck, a zero or blank if absent.

In the subsequent description of input data we find it convenient to refer to above fields 1, 2, 3, 4, 5, 6, 8, 9, 15, and 16 as Options identified by the respective field numbers. The other fields contain control numbers and will be referred to as Item 2, Field (respective number).

3. Constants cards (FORMAT 6E12.8): The two constants cards contain the items listed in the following order:

- a. CBAR: mean aerodynamic chord
- b. FLEXK: flexibility matrix normalizing constant (or scaling factor); when the matrix has not been normalized FLEXK = 1.0
- c. CAPS: surface reference area
- d. CAPZ: vertical force
- e. CAPH: generalized reference deflection
- f. CAPT: reference temperature change
- g. CAPN: reference load factor
- h. SMALS: surface span measured from root to tip
- i. CAPXO: coordinate pitching moment reference axis
- j. CAPHO: reference deflection for initial deflection mode

4. Dynamic pressures (FORMAT 6E12.8): If six or fewer dynamic pressures are listed, one card is used; seven through 10 pressures require two cards. The q card(s) are not required when performing Option 4 (divergence) above, but unless Item 2, Field 14 is zero or blank, the q's must be input and must agree with the number in this field.

5. The flexibility matrix [a] is input if its presence has been indicated in the data deck control card (Item 2, Field 18). If not included as input, a rigid case is assumed ($[a] = [0]$). The following card order and formats must be used when the matrix is input.

a. Control card (FORMAT 18I4)

Field 1. Columns 3 and 4 contain m, the number of rows in the matrix (≤ 50).

Field 2. This field is not used; it may be left blank.

Field 3. Column 12 contains IFORM; if IFORM = 1, the matrix elements are to be input using FORTRAN FORMAT 6E12.8; if IFORM = 0, the elements will be input using column binary format.

Field 4. Column 16 contains IROW; if IROW = 1, the matrix elements are input by row; if IROW = 0, the elements are input by column.

b. Matrix elements (use format specified above)

If IFORM = 1, and IROW = 1: use FORMAT 6E12.8 and input the matrix element by row; each new row starts on a new card (line).

If IFORM = 1, and IROW = 0: use FORMAT 6E12.8 and input the elements by column with each new column beginning on a new card.

If IFORM = 0, IROW must = 0: the matrix elements are input using column binary format. This format should be used only if the data are available as punched-card output from appropriate computer programs. The elements must be punched by columns; Column 1 starts in Origin 1 and Column 2 starts in Location (1 + m). A TRA card must end the deck. (This transfer card has a 7 and a 9 punch in Column 1, Columns 2 through 72 are blank, and Columns 73 through 80 will contain the characters used for identifying and sequencing the deck.)

6. The aerodynamic matrix [C_h] is always present in the data deck. It consists of two parts if external stores have been reserved in Item 2, Field 13, and it is real (steady case) unless indicated as complex (oscillatory case) in Item 2, Field 7. The [C_h] matrix must be entered as follows with this exception: Items a and b (below) will be omitted when no external stores are reserved:

a. Control card for store [C_h] (FORMAT 18I4)

Field 1. Columns 3 and 4 contain m, number of control points reserved for external stores (≤ 49); m = 0 will direct the program to set the store [C_h] to zero.

Field 2. This field is not used, it may be left blank.

Field 3. Column 12 contain IFORM as defined in Item 5a.

Field 4. Column 16 contains IROW as defined in Item 5a.

b. Store matrix elements (format specified in Fields 3 and 4, above control card): Omit this input if m = 0 is used in the control card. When the external stores [C_h] matrix is input, use the format in the manner described in Item 5b. If the matrix elements are complex numbers (oscillatory case) consider the matrix size as $m \times 2m$ (imaginary parts of the elements form the even-numbered columns) and input as though all elements were real numbers.

c. $1/k_r$ card (FORMAT 6E12.8): The reference reduced velocity card is always present. For the steady case, it may be blank or contain any number, but for the oscillatory case it must be the $1/k_r$ associated with the aerodynamic matrix.

d. Control card for surface [C_h] matrix (FORMAT 18I4)

Field 1. Columns 3 and 4 contain m, the number of control points on the surface. (m = size of system minus number of store control point.)

Field 2. Columns 7 and 8 contain L, the number of strips (partitions) in the surface. L = 1 for a full (unpartitioned) matrix.

Field 3. Column 12 contains IFORM as previously defined.

Field 4. Column 16 contains IROW as previously defined.

e. The input listed below must be repeated for each partition (i = 1, L).

(1) Partition size (FORMAT 18I4)

Field 1. Columns 3 and 4 contain n, the number of control points on strip i (size of partition i). If L = 1, n = total number of control points on the surface.

(2) Matrix elements in partition i (format specified in control card, Item 6d).

When the matrix is for the steady case the elements in each partition are input in the same manner as the elements in the [a] matrix (Item 5b). In the oscillatory case, the elements are entered in the same manner as described for the stores oscillatory $[C_h]$ matrix (Item 6b).

Note: Punched cards output from IBM programs based on the sources listed below may be used (with no alterations) for Items 6c, 6d, and 6e when the theory is appropriate to the problem. Punched cards output from the program based on slender-body theory may be used for Items 6a and 6b if the first card ($1/k_r$) is removed from the deck. The list shown is complete only at this writing; additional compatible sources are currently under development.

W. P. Rodden, E. F. Farkas, H. Malcom, and A. M. Kliszewski.
"Aerodynamic Influence Coefficients from Incompressible Strip Theory:
Analytical Development and Computational Procedure." Aerospace Corp.
Report No. TDR-169(3230-11)TN-5, 3 September 1962.

W. P. Rodden, E. F. Farkas, H. Malcom, and A. M. Kliszewski.
"Aerodynamic Influence Coefficients from Supersonic Strip Theory:
Analytical Development and Computational Procedure." Aerospace Corp.
Report No. TDR-169(3230-11)TN-1, 1 August 1962.

W. P. Rodden, E. F. Farkas, H. Malcom, and A. M. Kliszewski.
"Aerodynamic Influence Coefficients from Piston Theory: Analytical
Development and Computational Procedure." Aerospace Corp. Report
No. TDR-169(3230-11)TN-2, 15 August 1962.

W. P. Rodden, E. F. Farkas, and G. Y. Takata. "Aerodynamic
Influence Coefficients from Slender-Body Theory: Analytical Development
and Computational Procedure." Aerospace Corp. Report No.
TDR-169(3230-11)TN-6, 31 October 1962.

7. Weighting matrix: The weighting matrix $[W]$ is input if its presence has been indicated in Item 2, Field 10. The matrix is entered with formats identical to those given for the $[C_h]$ matrix (Item 6a, b, c, d, e) with three exceptions: (1) the $1/k_r$ card (Item 6c) is omitted; (2) in repeating Item 6a if $m = 0$ the program will use a unit matrix for the store $[W]$; and (3) the matrix is always real. It is not required that $[C_h]$ and $[W]$ be input with the same format in the same data deck; i.e., one may be in column binary while the other uses FORTRAN format, and one may be partitioned while the other is a full matrix.

8. Thermal influence coefficients matrix: The thermal matrix $[a_T]$ is input when Item 2, Field 11 notes its presence. The matrix is required input for Option 8. The formats for entering $[a_T]$ are the same as those used for the flexibility matrix: Items 5a and 5b.

9. Temperature distribution column (FORMAT 6E12.8): The temperature mode $\{t/T\}$ always accompanies the above thermal matrix. For steady cases (real AICs), the $\{t/T\}$ matrix is entered as one column, six elements per card. For oscillatory cases (complex AICs), the mode is complex with the imaginary part considered as a second column; tabulate by column with the second column starting a new card.

10. Experimental force column (FORMAT 6E12.8): The experimental force column $\{C_{zr}^{(e)}\}$ is input only if its presence has been indicated by Item 2, Field 12. The column (real or complex) is entered in the same manner as the column in Item 9.

11. Initial deflection mode (FORMAT 6E12.8): The initial deflection mode $\{h_r/H_0\}$, must be present to perform Option(s) 1, 2, 3, and/or 5. Again refer to Item 9 for entering the column (real or complex). If all elements in the column are zero, a sufficient number of blank cards may be used.

12. Additional deflection mode (FORMAT 6E12.8): The additional deflection $\{h/H\}$ must be included for Option(s) 1, 2, 3, and/or 6. See Items 9 and 11 for inputting this column (real or complex).

13. Mass matrix: The mass matrix $[M]$ must be in the data deck when performing Option(s) 1, 2, 3, and/or 9. The matrix is input as follows:

a. Control card 1 (FORMAT 18I4): Field 1 must contain NRC, order of the matrix (same as Item 2, Field 17).

b. Control card(s) 2 through 7 (FORMAT 18I4): Field 1 and consecutive fields in control card 2 and successive control cards contain in order LL_1 , LH_1 , LL_2 , LH_2 , ..., LL_{NRC} , LH_{NRC} . LL_i is the row number where the first nonzero element appears in column i; LH_i is the row number where the last nonzero element appears in column i. If only one nonzero element is in column i, its row number must be used for both LL_i and LH_i .

c. Elements in $[M]$ matrix (FORMAT 6E12.8): The elements are entered by column as shown below. Each column starts on a new line (card).

Column 1: elements LL_1 through LH_1

Column 2: elements LL_2 through LH_2

Column NRC: elements LL_{NRC} through LH_{NRC}

Any zero elements between LL_i and LH_i must be entered or their respective fields left blank. If all elements in a column are zero, then at least one element must be entered as zero (a blank card may be used); LL_i and LH_i for this zero element must appear in the above control cards.

14. Load factor column (FORMAT 6E12.8): The load factor column $\{n/N\}$ is included if [M] is used (Option(s) 1, 2, 3, and/or 9). If no correction is desired, input a unit column. The column is real for steady cases and complex for oscillatory cases. (See Item 9 for column input.)

15. Chordwise coordinates (FORMAT 6E12.8): The control point coordinate matrix $\{x\}$ or $[x]$ is input for Option(s) 2, 3, 5, 6, 8, 9, and/or 15. The matrix is entered only once (six elements per card) for any combination of the above options.

16. Spanwise coordinates (FORMAT 6E12.8): A spanwise control point coordinate matrix $[y]$ must be used with Option(s) 5, 6, 8, 9, and/or 15. The elements in $[y]$ are the control point distances from the roll axis.

17. Strip widths and control point locations (percent chord): The strip widths Δy_i and the control point locations $\xi_{i,j}$ (given as a fraction of the local chords) are required for Option(s) 5, 6, 8, 9, and/or 15. These data have the following input format.

a. Control card(s) (FORMAT 18I4)

Field 1. This field must contain $NSTRP$ = number of surface strips (maximum of 20 for above options). Do not include external stores as strips.

Field 2. Field 2 and successive fields contain $NCPT_i$ = number of control points (≤ 10) on strip i . ($i = 1, NSTRP$)

b. Δy_i and $\xi_{i,j}$ ($j = 1, NCPT_i$) (FORMAT 6E12.8): These data are entered by strips; each strip requires one line (card) when $NCPT \leq 5$ and two cards when $NCPT > 5$. Start with the first card for strip 1 and input the data as follows:

Field 1. Δy_1 : width of strip 1.

Field 2. ξ_1 1: location of first control point for strip 1.

Field 3. ξ_1 2: location of second control point for strip 1.

.

.

.

Field $(NCPT_1 + 1)$. $\xi_1 NCPT_1$: location of last control point for strip 1. (If $NCPT > 5$, then ξ_1 6 would be in Field 1, second card).

Repeat the above for each strip

18. Transformation matrices for structural loads: The shear, moment, and torque matrices, [V/F], [M/F], and [T/F], are input only if Option 16 is selected in conjunction with Option(s) 1, 2, or 3. The elements in any specific row of each matrix are the loads at a particular station due to a unit control point force.

The matrices are input in the order in which they are listed (above pp.) with each using the same format (similar to the mass matrix but input by rows instead of columns). The format for [V/F] is given below; the same format is used for [M/F] and [T/F].

a. Control card 1 (FORMAT 18I4): Field 1 contains NVMT, the number of rows in [V/F]. Note the matrix size is $(NVMT \times NRC)$, where NRC agrees with Item 2, Field 17 and $NVMT \leq 20$.

b. Control card(s) 2 through 7 (FORMAT 18I4): Field 1 and consecutive fields of these cards contain $LOW_1, LHIGH_1, LOW_2, LHIGH_2, \dots, LOW_{NVMT}, LHIGH_{NVMT}$. LOW_i is the column number of the first nonzero element in row i , and $LHIGH_i$ is the column number of the last nonzero element in row i . ($i = 1, NVMT$)

c. Elements of [V/F] (FORMAT 6E12.8): The elements are entered by row in the same manner as the columns in [M]. (Item 13c).

19. Second and successive "additional deflection mode" columns
(FORMAT 6E12.8): It is possible to vary the additional deflection modal column
 $\{h/H\}$ to obtain two or more solutions for real or complex aerodynamic
 stability derivatives. Use the input format given for Item 9 (or 12) repeating
 the format for each new column.

C. Table of Option Requirements

To aid the program user in data deck setup, the following table shows
 which of the above described 19 data items are required to make up a data
 deck for any option.

DATA ITEM

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
OPTION	P	P	P	P	P	P	O	O	O	O	P	P	P	P	A	A	A	-	A
1	P	P	P	P	P	P	O	O	O	O	P	P	P	P	P	A	A	-	A
2	P	P	P	P	P	P	O	O	O	O	P	P	P	P	P	A	A	-	A
3	P	P	P	P	P	P	O	O	O	O	P	P	P	P	P	A	A	-	A
4	P	P	P	A	P	P	O	A	A	A	A	A	A	A	A	A	A	A	A
5	P	P	P	P	O	P	O	A	A	O	P	A	A	A	P	P	P	A	A
6	P	P	P	P	O	P	O	A	A	A	A	P	A	A	P	P	P	A	O
8	P	P	P	P	O	P	O	P	P	A	A	A	A	A	P	P	P	A	A
9	P	P	P	P	O	P	O	A	A	A	A	A	A	P	P	P	P	A	A
15	P	P	P	P	P	P	O	A	A	P	A	A	A	A	P	P	P	A	A
16	← Set up for option (1, 2, or 3) being performed →																		A P A

P = must be present; A = must be absent; O = optional inclusion;

-- present when Option 16 is used with Option 1, 2, or 3.

Note: The above table applies to options performed singly with the exception of Option 16 which must be used concurrently with Option 1, 2, or 3. Where multiple options are to be performed with one data deck and an item must be present for one of the options and absent for another, that item must be included in the data deck. Also any data item indicated as present in the control card (Item 2) must be included in the deck, even though it may not be used in the particular option(s) chosen.

D. Example Keypunch Forms

Example keypunch forms are given on the following pages. Columns 73 through 80 are reserved for data deck identification and sequencing. Only the cards with sequencing are used in the two data decks set up for the example problem; the lines with Columns 73 through 80 left blank are for description of input.

The matrix elements can be seen in the printed output. The control card gives the size and specifies the format (**FORTRAN** 6E12.8, by rows) used to input [•] in this problem. (See Section III, Part B, Item 5 for other input formats.)

Control Card for Aerodynamic Matrix $[C_a]$		
10	1	0
The above card specifies a 10×10 (unpartitioned) matrix input using FORTRAN format 6E12.8 with the elements entered by columns.	$[C_a]$ Matrix Elements	H M 0 3 0 0 2 8
	Partition Size	H M 0 3 0 0 2 9
		H M 0 3 0 0 3 0
Control Card for Weighting Matrix $[W]$		
10	5	1
This control card calls for a 10×10 matrix with five partitions, each partition is input using FORTRAN format: 6E12.8 with the elements entered by row.	Size and Elements for Each Partition	H M 0 3 0 5 0

HMO 30051	
2	
-1.0	0.0
0.0	-1.0
2	
-1	+0.1 -0.0
0	+0.0 -
0	+0.1
2	
-1.0	0.0
0.0	-1.0
2	
-1.0	0.0
0.0	-1.0
2	
HMO 30055	

The unit weighting matrix is not required input; we use it here to show format. (Refer to Section III, Part B, Item 7.)

Initial Deflection Mode $[h_1/H_0]$ (Format 6E12.8)									
Additional Deflection Mode $[h/H]$ (Format 6E12.8)									
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	HMO30066
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	67
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	68
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	68
Size Card for Mass Matrix $[M]$									
10	10	10	10	10	10	10	10	10	70
First and Last (LL_i and LU_i) Nonzero Element in Each Column of $[M]$									
1	2	1	2	3	4	3	4	5	6
9	10	9	10	9	10	9	10	9	10
$[M]$ Matrix Elements (Format 6E12.8)									
53836	+04-134.9								73
-134.9		9252	+03						74
20732	+05-11005	+05							75
-11005	+05	11478.0							76
3113.9		139.7							77
139.7		806.6							HMO30078
1214.1	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	78
1214.1	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	79
1214.1	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	80
1214.1	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	81
1214.1	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	82
1214.1	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	83
1214.1	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	84
1214.1	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	85
1214.1	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	86
1214.1	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	87
1214.1	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	88
1214.1	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	89
1214.1	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	90
1214.1	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	91
1214.1	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	92
1214.1	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	93
1214.1	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	94
1214.1	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	95
1214.1	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	96
1214.1	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	97
1214.1	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	98
1214.1	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	99
1214.1	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100

The above sequenced cards make up the first deck for the example contained
home and difference problems.

EXAMPLE PROBLEM-AERODYNAMIC STABILITY AND INERTIAL DERIVATIVES										HMO31001
Data Deck Control Card										
Dynamic Pressures										
0.0	400.0	800.0	1200.0	0.05						
Additional Deflection Mode [h/H]										
-3.5343	+00+1.41371	+00-31154	+00+124616	+01-27576	+00+110304	+01				68
-2.3213	+00+92851	+00-19286	+00+77143	+00						69
Spanwise Coordinates [y]										
90.0	90.0	186.0	186.0	268.0	268.0					67
368.0	368.0	458.0	458.0							68
Number of Strips and Number of Control Points per Strip										
5	2	2	2	2	2					69
Strip Widths (Δy) and Percent Chord Locations ($c_{k,j}$) of Control Points										
93.0	25	+00	75	+00						90
89.0	25	+00	75	+00						91
91.0	25	+00	75	+00						92
95.0	25	+00	75	+00						93

The data deck for the example derivative option is set up using the above sequenced cards plus the following cards from the previous deck.

MW030003-04	-	Constant Cards
06-26	-	Flexibility Matrix
27-49	-	Aerodynamic Matrix
50-65	-	Weighting Matrix
70-84	-	Mass Matrix and Load Factor Column
MW030085-86	-	Circumferential Coordinates

SECTION IV
PROGRAM OUTPUT

A. Output for Each Option

In addition to all input data, the following is printed for each option.

1. Option 1 (for each dynamic pressure)
 - a. Deformation mode
 - b. Total deflection mode
 - c. Final aerodynamic force distribution
 - d. Total force distribution
2. Option 2 (for each dynamic pressure)
 - a. Incremental pitch angle
 - b. Deformation mode
 - c. Total deflection mode
 - d. Final aerodynamic force distribution
 - e. Total force distribution
3. Option 3 (for each dynamic pressure)
 - a. Aerodynamic lift
 - b. Incremental pitch angle
 - c. Deformation mode
 - d. Total deflection mode
 - e. Final aerodynamic force distribution
 - f. Total force distribution

4. Option 4 (divergence)

a. For each mode: mode number, eigenvalue, divergence pressure, and number of iterations

b. Divergence modes (eigenvectors)

c. Check eigenvalues

d. Check eigenvectors

5. Options 5, 6, 7, 8, and 9 (for each dynamic pressure)

a. Distributed force coefficients

b. Aerodynamic normal force, pitching moment, and rolling moment coefficients

c. Total chordwise center of pressure

d. Total spanwise center of pressure

e. For each strip: spanwise loading and local center of pressure.

6. Option 15 (for each dynamic pressure)

a. Corrected experimental force coefficients

b. Aerodynamic normal force, pitching moment, and rolling moment coefficients

c. Total chordwise center of pressure

d. Total spanwise center of pressure

e. For each strip: spanwise loading and local center of pressure.

7. Option 16 (for each dynamic pressure)

a. All data listed under the associated option (1, 2, or 3).

b. Shear, moment, and torque at load stations.

B. Example Printout

The printout for the example problem is shown on the following pages. Some of the results shown may be compared with similar calculations presented in Ref. 7.

EXAMPLE PROBLEM - TRIMMED LOADS AND DIVERGENCE OPTIONS

01

CONTROL ITEMS									
(1)=0	(2)= 1	(3)=-0	(4)= 2	(5)=-0	(6)=-0	(7)=-0	(8)=-0	(9)=-0	
(10)= 1	(11)=-0	(12)=-0	(13)=-0	(14)= 3	(15)=-0	(16)= 1	(17)=10	(18)=1	
CBAR	NORM CONST	CAPS							KEF H
0.22455999E 03	0.59599999E-07	0.56423599E 03			-0.41919000E 05				0.09999999E 01
REF T	REF N	SMS			X0				REF HO
0.	0.09999999E 01	0.50000000E 03			0.				0.

0.40000000E 03 0.80000000E 03 0.12000000E 04

3 DYNAMIC PRESSURES

FLEXIBILITY MATRIX

	COLUMN	1	2	3	4	5	COLUMN
1	0.87171999E 02	0.13361000E 02	0.12778CC0E 03	0.62719999E 02	0.16250999E 03	0.10492200E 03	
2	0.13361000E 02	0.30866999E 03	0.62719999E 02	0.32279000E 03	0.10492200E 03	0.33528999E 03	
3	0.12778CC0E 03	0.62719999E 02	0.27732000E 03	0.15725999E 03	0.48255000E 03	0.37627999E 03	
4	0.62719999E 02	0.32297000E 03	0.15725999E 03	0.63799000E 03	0.37627999E 03	0.80135999E 03	
5	0.16250999E 03	0.10492200E 03	0.48255000E 03	0.37627999E 03	0.12757999E 04	0.11342299E 04	
6	0.10492200E 03	0.33528999E 03	0.37627999E 03	0.80135999E 03	0.11342299E 04	0.16999000E 04	
7	0.20478C00E 03	0.73283599E 03	0.64337799E 03	0.64337799E 03	0.19350000E 04	0.18160000E 04	
8	0.15625599E 03	0.35021000E 03	0.64337799E 03	0.10012100E 04	0.18160000E 04	0.22920000E 04	
9	0.24285C00E 03	0.20257000E 03	0.9581C001E 03	0.88378000E 03	0.25283000E 04	0.24293999E 04	
10	0.20402999E 03	0.35784999E 03	0.88378CC0E 03	0.11810599E 04	0.24293999E 04	0.28248999E 04	
	COLUMN	7	8	9	10	COLUMN	
1	0.20478000E 03	0.15629999E 03	0.24285000E 03	0.20429999E 03	0.20429999E 03		
2	0.15625599E 03	0.35021000E 03	0.20257000E 03	0.35784999E 03	0.35784999E 03		
3	0.73283599E 03	0.64337799E 03	0.95809998E 03	0.88378000E 03	0.88378000E 03		
4	0.64337799E 03	0.10012100E 04	0.88378CC0E 03	0.11810599E 04	0.11810599E 04		
5	0.19350000E 04	0.18160000E 04	0.25283000E 04	0.24293999E 04	0.24293999E 04		
6	0.18160000E 04	0.22920000E 04	0.24293999E 04	0.28248999E 04	0.28248999E 04		
7	0.36861999E 04	0.35051999E 04	0.52675000E 04	0.51171000E 04	0.51171000E 04		
8	0.35051999E 04	0.42291999E 04	0.51171000E 04	0.57186999E 04	0.57186999E 04		
9	0.52675000E 04	0.51171000E 04	0.84840000E 04	0.82340000E 04	0.82340000E 04		
10	0.51171C00E 04	0.57186999E 04	0.82340000E 04	0.92340000E 04	0.92340000E 04		

AERODYNAMIC INFLUENCE COEFFICIENTS REAL 1/KR = 0.

	COLUMN 1	COLUMN 2	COLUMN 3	COLUMN 4	COLUMN 5	COLUMN 6
1	0.11040550E 01	-0.11040550E 01	0.-44035111E-00	-0.-44035111E-00	0.23558389E-00	-0.-23558389E-00
2	-0.-65710617E-01	0.-65710617E-01	0.-29845580E-01	-0.-29845580E-01	0.-31780227E-01	-0.-31780227E-01
3	0.-39277381E-00	-0.-39277381E-00	0.-98089795E 00	-0.-98089795E 00	0.-38376644E-00	-0.-38376643E-00
4	0.-26774842E-01	-0.-26774842E-01	-0.-80031395E-01	0.-80031395E-01	0.-27342293E-01	-0.-27342293E-01
5	0.27598643E-00	-0.27598643E-00	0.27460741E-C0	-0.27460741E-C0	0.10764901E 01	-0.10764901E 01
6	0.-26934370E-02	-0.-26934370E-02	0.-29652580E-01	-0.-29652578E-01	-0.86809320E-01	0.-86809350E-01
7	-0.-32916859E-00	0.-32916859E-00	0.-48047283E-00	-0.-48047283E-00	0.15607686E-00	-0.-15607686E-00
8	0.-99114150E-01	-0.-99114150E-01	-0.-50967707E-01	0.-50967722E-01	0.-53080060E-01	-0.-53080063E-01
9	0.-14902235E 01	-0.-14902235E 01	-0.-10267259E 01	0.-10267259E 01	0.-63286462E 00	-0.-63286462E 00
10	-0.-29457279E-00	0.-29457279E-00	0.21437690E-C0	-0.21437693E-00	-0.-98096674E-01	0.-980966689E-01

	COLUMN 7	COLUMN 8	COLUMN 9	COLUMN 10	COLUMN 11
1	0.-15978687E-00	-0.-15978687E-00	0.-86297289E-01	-0.-86297289E-01	-0.-94341008E-02
2	0.-19449846E-01	-0.-19449846E-01	0.-94341008E-02	-0.-94341008E-02	-0.-10024159E-00
3	0.19948611E-00	-0.19948611E-00	0.10024159E-C0	-0.10024159E-C0	-0.11618502E-01
4	0.-26146957E-01	-0.-26146957E-01	0.-11618502E-01	-0.-11618502E-01	-0.-14753119E-00
5	0.-38184877E-00	-0.-38184877E-00	0.-14753119E-C0	-0.-14753119E-C0	-0.-19046080E-01
6	0.-32687288E-01	-0.-32687288E-01	0.-19046080E-01	-0.-19046080E-01	-0.-32880831E-00
7	0.-12575267E 01	-0.-12575267E 01	0.-32880831E-00	-0.-32880831E-00	-0.-30007008E-01
8	-0.-888885278E-01	0.-888885278E-01	0.30007008E-01	-0.30007008E-01	-0.-10493460E 01
9	0.-96738150E-01	-0.-96738150E-01	0.-10493460E 01	-0.-10493460E 01	-0.-81901712E-01
10	0.-48441701E-01	-0.-48441701E-01	-0.-81901712E-01	-0.-81901712E-01	-0.-99999999E 01

WEIGHTING MATRIX

	COLUMN 1	COLUMN 2	COLUMN 3	COLUMN 4	COLUMN 5	COLUMN 6
1	0.09999999E 01	0.-09999999E 01	0.-09999999E 01	0.-09999999E 01	0.-09999999E 01	0.-09999999E 01
2	0.-09999999E 01					
3	0.-09999999E 01					
4	0.-09999999E 01					
5	0.-09999999E 01					
6	0.-09999999E 01					
7	0.-09999999E 01					
8	0.-09999999E 01					
9	0.-09999999E 01					
10	0.-09999999E 01					

COLUMN	7	COLUMN	8	COLUMN	9	COLUMN	10	COLUMN
1	0.	0.	0.	0.	0.	0.	0.	0.
2	0.	0.	0.	0.	0.	0.	0.	0.
3	0.	0.	0.	0.	0.	0.	0.	0.
4	0.	0.	0.	0.	0.	0.	0.	0.
5	0.	0.	0.	0.	0.	0.	0.	0.
6	0.	0.	0.	0.	0.	0.	0.	0.
7	0.05999999E 01	0.	0.09999999E 01	0.	0.09999999E 01	0.	0.09999999E 01	0.
8	0.	0.	0.	0.	0.	0.	0.	0.
9	0.	0.	0.	0.	0.	0.	0.	0.
10	0.	0.	0.	0.	0.	0.	0.	0.

INITIAL DEFLECTION MODE (H0/REF H0)
REAL

1	-0.
2	-0.
3	-0.
4	-0.
5	-0.
6	-0.
7	-0.
8	-0.
9	-0.
10	-0.

ADDITIONAL DEFLECTION MODE (H1/REF H1)
REAL

1	0.
2	-0.
3	-0.
4	-0.
5	-0.
6	-0.
7	0.
8	-0.
9	-0.
10	-0.

MASS MATRIX

	COLUMN 1	COLUMN 2	COLUMN 3	COLUMN 4	COLUMN 5	COLUMN 6
1	9.53835999E 04	-0.13490000E 03	0.	0.	0.	0.
2	-0.13490000E 03	0.92519999E 03	0.	0.	0.	0.
3	0.	0.	0.20732000E 05	-0.11004999E 05	0.	0.
4	0.	0.	-0.11004999E 05	0.-11477999E 05	0.	0.
5	0.	0.	0.	0.	0.31139000E 04	0.13970000E 03
6	0.	0.	0.	0.	0.13970000E 03	0.-80660000E 03
7	0.	0.	0.	0.	0.	0.
8	0.	0.	0.	0.	0.	0.
9	0.	0.	0.	0.	0.	0.
10	0.	0.	0.	0.	0.	0.
	COLUMN 7	COLUMN 8	COLUMN 9	COLUMN 10		
1	0.	0.	0.	0.		
2	0.	0.	0.	0.		
3	0.	0.	0.	0.		
4	0.	0.	0.	0.		
5	0.	0.	0.	0.		
6	0.	0.	0.	0.		
7	0.26387599E 04	-0.20999999E 02	0.	0.		
8	-0.20999999E 02	0.80329999E 03	0.	0.		
9	0.	0.	0.48750000E 03	0.72999999E 01		
10	0.	0.	0.72999999E 01	0.17785999E 03		

LOAD FACTOR MODE
REAL

1	0.09999999E 01
2	0.09999999E 01
3	0.09999999E 01
4	0.09999999E 01
5	0.09999999E 01
6	0.09999999E 01
7	0.09999999E 01
8	0.09999999E 01
9	0.09999999E 01
10	0.09999999E 01

CHORDWISE COORDINATES
REAL

1 0.20249999E 02
2 -0.80599599E 02
3 0.17850300E 02
4 -0.71399199E 02
5 0.15799999E 02
6 -0.63199999E 02
7 0.13299999E 02
8 -0.53200000E 02
9 0.11049999E 02
10 -0.44199999E 02

SHEAR COEFFICIENT MATRIX

	COLUMN 1	COLUMN 2	COLUMN 3	COLUMN 4	COLUMN 5	COLUMN 6
1	0.05555599E 01	0.05999999E 01	0.09999999E 01	0.09999999E 01	0.09999999E 01	0.09999999E 01
	COLUMN 7	COLUMN 8	COLUMN 9	COLUMN 10	COLUMN	
1	0.05999999E 01	0.09999999E 01	0.09999999E 01	0.09999999E 01	COLUMN	

MOMENT COEFFICIENT MATRIX

	COLUMN 1	COLUMN 2	COLUMN 3	COLUMN 4	COLUMN 5	COLUMN 6
1	0.4500000E 02	0.4500000E 02	0.1410000E 03	0.1410000E 03	0.2230000E 03	0.2230000E 03
	COLUMN 7	COLUMN 8	COLUMN 9	COLUMN 10	COLUMN	
1	0.3230000E 03	0.3230000E 03	0.4130000E 03	0.4130000E 03	COLUMN	

TORQUE COEFFICIENT MATRIX

	COLUMN 1	COLUMN 2	COLUMN 3	COLUMN 4	COLUMN 5	COLUMN 6
1	-0.20245999E 02	0.8099999E 02	-0.1785000E 02	0.7139999E 02	-0.1579999E 02	0.6319999E 02
	COLUMN 7	COLUMN 8	COLUMN 9	COLUMN 10	COLUMN	
1	-0.13255999E 02	0.5320000E 02	-0.1104999E 02	0.4419999E 02	COLUMN	

LOADS FOR TRIMMED CONDITION

DYNAMIC PRESSURE = 0.4000000E 03

AERODYNAMIC LIFT (Z) = -0.41919000E 05

INCREMENTAL PITCH ANGLE = 0.46606336E-01

	DEFORMATION MODE	TOTAL DEFLECTION MODE	TOTAL FORCE DISTRIBUTION	SHEAR AT LOAD STATIONS
1	-0.35778464E-00	1 -0.13015629E 01	1 -0.39714313E 04	-0.17399999E 05
2	-0.16302317E-00	2 0.36120900E 01	2 0.75146689E 03	-0.51627593E 07
3	-0.12215040E 01	3 -0.20534271E 01	3 0.79779468E 03	0.53663919E 06
4	-0.91019940E 00	4 0.24174929E 01	4 0.45841973E 03	
5	-0.31506635E 01	5 -0.38870436E 01	5 -0.55609780E 04	
6	-0.276222538E 01	6 0.18326655E-00	6 0.97793347E 03	
7	-0.60628324E 01	7 -0.66826966E 01	7 -0.40783482E 04	
8	-0.55978061E 01	8 -0.31183490E 01	8 0.52939943E 03	
9	-0.92359689E 01	9 -0.97509689E 01	9 -0.84639199E 04	
10	-0.86867576E 01	10 -0.66267575E 01	10 0.11596636E 04	

LOADS FOR TRIMMED CONDITION

DYNAMIC PRESSURE = 0.8000000E 03

AERODYNAMIC LIFT (Z) = -0.4191900E 05

INCREMENTAL PITCH ANGLE = 0.209981035E-01

	DEFORMATION MODE	TOTAL DEFLECTION MODE
1	-0.36199015E-00	-0.78685611E 00
2	-0.16960739E-00	0.15298564E 01
3	-0.12451448E 01	-0.16196562E 01
4	-0.93552055E 00	0.56252537E 00
5	-0.32219631E 01	-0.35534634E 01
6	-0.28336892E 01	-0.15076878E 01
7	-0.62063475E 01	-0.64853952E 01
8	-0.57386997E 01	-0.46225086E 01
9	-0.94494957E 01	-0.96813361E 01
10	-0.88997614E 01	-0.79723996E 01

FINAL AERODYNAMIC FORCE DISTRIBUTION

	TOTAL FORCE DISTRIBUTION
1	-0.36703358E 04
2	0.72958063E 03
3	0.94303796E 03
4	0.44915283E 03
5	-0.55822740E 04
6	0.97280791E 03
7	-0.44233255E 04
8	0.5623450E 03
9	-0.84930255E 04
10	0.11181471E 04

-0.17360999E 05

-0.52588411E 07

0.53602992E 06

SHEAR AT LOAD STATIONS

MOMENT AT LOAD STATIONS

TORQUE AT LOAD STATIONS

LOADS FOR TRIMMED CONDITION

DYNAMIC PRESSURE = 0.12000000E 04

AERODYNAMIC LIFT (Z) = -0.419190COE 05

INCREMENTAL PITCH ANGLE = 0.12441241E-01

DEFORMATION MODE

	DEFORMATION MODE	TOTAL DEFLECTION MODE
1	-0.36626212E-00	1 -0.61819725E 00
2	-0.17629514E-00	2 0.83144537E 00
3	-0.12691572E 01	3 -0.14.912333E 01
4	-0.96123845E 00	4 -0.7293845E-01
5	-0.329444059E 01	5 -0.34909774E 01
6	-0.29062601E 01	6 -0.21199737E 01
7	-0.63520887E 01	7 -0.65175571E 01
8	-0.58817549E 01	8 -0.52198608E 01
9	-0.966661822E 01	9 -0.98036578E 01
10	-0.91159250E 01	10 -0.85660221E 01

FINAL AERODYNAMIC FORCE DISTRIBUTION

	FINAL AERODYNAMIC FORCE DISTRIBUTION	TOTAL FORCE DISTRIBUTION
1	-0.86130322E 04	1 -0.33643322E 04
2	-0.82933617E 02	2 0.7036637E 03
3	-0.86355639E 04	3 0.10914361E 04
4	-0.33407719E 02	4 0.43959228E 03
5	-0.88579584E 04	5 -0.56042585E 04
6	0.21282013E 02	6 0.96758201E 03
7	-0.73939513E 04	7 -0.47761513E 04
8	-0.19848777E 03	8 0.58381222E 03
9	-0.90156926E 04	9 -0.85208927E 04
10	0.89064544E 03	10 0.10758454E 04

SHEAR AT LOAD STATIONS

-0.17399999E 05

MOMENT AT LOAD STATIONS

-0.536665973E 07

TORQUE AT LOAD STATIONS

0.52331747 E 06

DIVERGENCE OPTION

MODE	LAMBDA	DIVERGENT Q	NO. ITERATIONS
1	0.10533979E 04	0.37855625E 04	7
2	0.14795922E 03	0.26951299E 05	17
MODAL COLUMNS NORMALIZED ON THE LARGEST ELEMENT			
COLUMN 1		COLUMN 2	COLUMN
1	0.46074241E-01	0.12451124E-01	
2	0.30984621E-01	0.23911460E-01	
3	0.14665693E-00	0.92819538E-01	
4	0.12125430E-00	0.10511485E-00	
5	0.36689373E-00	0.28864431E-00	
6	0.33670042E-00	0.29455201E-00	
7	0.67907555E 00	0.63256484E 00	
8	0.64371622E 00	0.62138908E 00	
9	0.09999999E 01	0.09999999E 01	
10	0.96211223E 00	0.98270668E 00	
CHECK EIGENVALUES AND EIGENVECTORS			
COLUMN 1		COLUMN	COLUMN
1	0.10533956E 04		
2	0.14795691E 03		
COLUMN 1		COLUMN 2	COLUMN
1	0.46074230E-01	0.12450930E-01	
2	0.30984621E-01	0.23911376E-01	
3	0.14665692E-00	0.92818607E-01	
4	0.12125429E-00	0.10511468E-00	
5	0.36689373E-00	0.28864340E-00	
6	0.33670041E-00	0.29455151E-00	
7	0.67907548E 00	0.63256406E 00	
8	0.64371625E 00	0.62138890E 00	
9	0.09999999E 01	0.09999999E 01	
10	0.96211215E 00	0.98270634E 00	

EXAMPLE PROBLEM - AERODYNAMIC STABILITY AND INERTIAL DERIVATIVES

10

CONTROL ITEMS					
(1)=0	(2)=0	(3)=0	(4)=0	(5)=0	(6)=1
(10)=1	(11)=0	(12)=0	(13)=0	(14)=4	(15)=0
					(16)=0
					(17)=10
					(18)=1
CBAR	NORM CONST	CAPS	$\frac{Z}{L}$		REF H
0.2249999E 03	0.9999999E-07	0.56423599E 03	-0.41919000E 05		0.09999999E 01
REF T	REF N	SMS	X0		REF HO
0.	0.05955999E 01	0.50000000E 03	0.		0.

4 DYNAMIC PRESSURES

EXHIBIT MATEIX

COLUMN		COLUMN		COLUMN		COLUMN		COLUMN		COLUMN	
1	2	3	4	5	6	7	8	9	10	11	12
0. 87171999E 02	0. 13361000E 02	0. 12778C00E 03	0. 62711999E 02	0. 16250999E 03	0. 10492200E 03	0. 20402999E 03	0. 24285000E 03	0. 20402999E 03	0. 24285000E 03	0. 24285000E 03	0. 24285000E 03
1 0. 13361C00E 02	0. 30860999E 03	0. 62711999E 02	0. 32297C00E 03	0. 10492200E 03	0. 33528999E 03	0. 32297C00E 03	0. 33528999E 03	0. 32297C00E 03	0. 33528999E 03	0. 33528999E 03	0. 33528999E 03
2 0. 12778C00E 03	0. 62711999E 02	0. 27732000E 03	0. 15725999E 03	0. 48255000E 03	0. 37627999E 03	0. 63749000E 03	0. 37627999E 03	0. 63749000E 03	0. 37627999E 03	0. 37627999E 03	0. 37627999E 03
3 0. 62711999E 02	0. 32237199E 03	0. 15725999E 03	0. 48255000E 03	0. 63749000E 03	0. 37627999E 03	0. 63749000E 03	0. 37627999E 03	0. 63749000E 03	0. 37627999E 03	0. 37627999E 03	0. 37627999E 03
4 0. 62711999E 02	0. 10492200E 03	0. 33528999E 03	0. 37627999E 03	0. 80135999E 03	0. 12757999E 04						
5 0. 16250999E 03	0. 10492200E 03	0. 35021000E 03	0. 64333799E 03	0. 19350000E 04	0. 11344299E 04	0. 35021000E 03	0. 64333799E 03	0. 19350000E 04	0. 11344299E 04	0. 35021000E 03	0. 64333799E 03
6 0. 10492200E 03	0. 15626999E 03	0. 20257000E 03	0. 64333799E 03	0. 18160000E 04	0. 16999000E 04	0. 20257000E 03	0. 64333799E 03	0. 18160000E 04	0. 16999000E 04	0. 20257000E 03	0. 64333799E 03
7 0. 20478C00E 03	0. 15626999E 03	0. 20257000E 03	0. 64333799E 03	0. 10012100E 04	0. 18160000E 04	0. 20257000E 03	0. 64333799E 03	0. 10012100E 04	0. 18160000E 04	0. 20257000E 03	0. 64333799E 03
8 0. 15626999E 03	0. 24285C00E 03	0. 35784999E 03	0. 88378C00E 03	0. 88378000E 03	0. 25283000E 04	0. 24285C00E 03	0. 88378C00E 03	0. 88378000E 03	0. 25283000E 04	0. 24285C00E 03	0. 88378C00E 03
9 0. 24285C00E 03	0. 20402999E 03	0. 35784999E 03	0. 88378C00E 03	0. 11810599E 04	0. 24293999E 04	0. 20402999E 03	0. 88378C00E 03	0. 11810599E 04	0. 24293999E 04	0. 20402999E 03	0. 88378C00E 03
10 0. 20402999E 03	0. 24293999E 04	0. 35784999E 03	0. 88378C00E 03	0. 11810599E 04	0. 24293999E 04	0. 24293999E 04	0. 88378C00E 03	0. 11810599E 04	0. 24293999E 04	0. 24293999E 04	0. 24293999E 04

AERODYNAMIC INFLUENCE COEFFICIENTS REAL I/KR = 0.

	COLUMN	1	COLUMN	2	COLUMN	3	COLUMN	4	COLUMN	5	COLUMN	6
1	0.11040550E 01	-0.11040550E 01	0.-44035111E-00	-0.44035111E-00	0.-23558388E-00	-0.-23558388E-00						
2	-0.65710617E-01	-0.65710617E-01	0.29845580E-01	-0.29845580E-01	0.31780227E-01	-0.31780227E-01						
3	0.39277381E-00	-0.39277381E-00	0.98089795E 00	-0.98089795E 00	0.38376644E-00	-0.38376644E-00						
4	0.-26774842E-01	-0.-26774842E-01	-0.80031395E-01	0.-80031395E-01	-0.27342293E-01	-0.-27342293E-01						
5	0.27598643E-00	-0.27598643E-00	0.27460741E-00	-0.27460741E-00	0.10764901E 01	-0.10764901E 01						
6	0.-26934370E-02	-0.-26934370E-02	0.29652580E-01	-0.29652580E-01	-0.868809320E-01	0.-868809320E-01						
7	-0.-32916859E-00	-0.-32916859E-00	0.-48047283E-00	-0.-48047283E-00	0.15607686E-00	-0.15607686E-00						
8	0.-89114150E-01	-0.-99114150E-01	-0.-50967707E-01	-0.-50967707E-01	0.-53080060E-01	-0.-53080060E-01						
9	0.-14902235E 01	-0.-14902235E 01	-0.-10267299E 01	-0.-10267299E 01	0.-63286462E 00	-0.-63286462E 00						
10	-0.-29457279E-00	-0.29457279E-00	0.21437690E-00	-0.21437693E-00	-0.-98096669E-01	0.-98096669E-01						

WEIGHTING MATRIX

	COLUMN	7	COLUMN	8	COLUMN	9	COLUMN	10	COLUMN	11	COLUMN	12
1	0.159786607E-00	-0.159786607E-00	0.-86297289E-01	-0.-86297289E-01	-0.94341008E-02	-0.-94341008E-02						
2	0.19449846E-01	-0.19449846E-01	0.94341008E-02	-0.94341008E-02	0.10024159E-00	-0.10024159E-00						
3	0.19948611E-00	-0.19948611E-00	0.10024159E-00	-0.10024159E-00	0.11618502E-01	-0.11618502E-01						
4	0.26146957E-01	-0.26146957E-01	0.11618502E-01	-0.11618502E-01	0.14753119E-00	-0.14753119E-00						
5	0.38184877E-00	-0.38184877E-00	0.14753119E-00	-0.14753119E-00	0.190460608E-01	-0.190460608E-01						
6	0.32687288E-01	-0.32687288E-01	0.190460608E-01	-0.190460608E-01	0.32880831E-00	-0.32880831E-00						
7	0.-12575267E 01	-0.-12575267E 01	0.32880831E-00	-0.32880831E-00	0.30007008E-01	-0.30007008E-01						
8	-0.-888885278E-01	-0.-888885278E-01	0.30007008E-01	-0.30007008E-01	0.10493460E 01	-0.10493460E 01						
9	0.-96738150E-01	-0.-96738150E-01	0.10493460E 01	-0.10493460E 01	-0.81901712E-01	0.81901712E-01						
10	0.48441701E-01	-0.48441701E-01	-0.81901712E-01	0.81901712E-01								

	COLUMN	7	COLUMN	8	COLUMN	9	COLUMN	10	COLUMN
1	0.	0.	0.	0.	0.	0.	0.	0.	0.
2	0.	0.	0.	0.	0.	0.	0.	0.	0.
3	0.	0.	0.	0.	0.	0.	0.	0.	0.
4	0.	0.	0.	0.	0.	0.	0.	0.	0.
5	0.	0.	0.	0.	0.	0.	0.	0.	0.
6	0.	0.	0.	0.	0.	0.	0.	0.	0.
7	0.	0.05599999E 01	0.	0.	0.	0.	0.	0.	0.
8	0.	0.	0.099999999E 01	0.	0.	0.099999999E 01	0.	0.	0.
9	0.	0.	0.	0.	0.	0.	0.	0.	0.
10	0.	0.	0.	0.	0.	0.	0.	0.	0.

ADDITIONAL DEFLECTION MODE (H/REF H)
REAL

1	-0.35343000E-00
2	0.14137100E 01
3	-0.31153999E-00
4	0.12461600E 01
5	-0.27575999E-00
6	0.11030400E 01
7	-0.23213000E-00
8	0.92851000E 00
9	-0.19286000E-00
10	0.77142999E 00

MASS MATRIX

	COLUMN	1	COLUMN	2	COLUMN	3	COLUMN	4	COLUMN	5	COLUMN	6
1	0.	0.53835999E 04	-0.13490000E 03	0.	0.	0.	0.	0.	0.	0.	0.	0.
2	0.	-0.13490000E 03	0.92251999E 03	0.	0.	0.	0.	0.	0.	0.	0.	0.
3	0.	0.	0.	0.20732000E 05	-0.11004999E 05	0.	0.	0.	0.	0.	0.	0.
4	0.	0.	0.	-0.11004999E 05	0.11477999E 05	0.	0.	0.	0.	0.	0.	0.
5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
6	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
7	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
8	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
9	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
10	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

	0.	0.	0.
1	0.	0.	0.
2	0.	0.	0.
3	0.	0.	0.
4	0.	0.	0.
5	0.	0.	0.
6	0.	0.	0.
7	0.26387599E 04	-0.20999999E 02	0.
8	-0.20959999E 02	0.80329999E 03	0.
9	0.	0.	0.48750000E 03
10	0.	0.	0.72599999E 01

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1	0.90000000E 02
2	0.90000000E 02
3	0.18600000E 03
4	0.18600000E 03
5	0.26800000E 03
6	0.26800000E 03
7	0.36800000E 03
8	0.36800000E 03
9	0.45800000E 03
10	0.45800000E 03

INPUT DATA FOR LOAD DISTRIBUTION CALCULATIONS

5 STRIPS

STRIP	CONTROL POINTS
1	2
2	2
3	2
4	2
5	2

STRIP	DELTA Y(I)	CHORDWISE CONTROL POINT LOCATIONS (PERCENT CHORD)
1	0.9300000E 02	0.25000000E-00 0.7500000E 00
2	0.8900000E 02	0.25000000E-00 0.7500000E 00
3	0.9100000E 02	0.25000000E-00 0.7500000E 00
4	0.9500000E 02	0.25000000E-00 0.7500000E 00
5	0.8700000E 02	0.25000000E-00 0.7500000E 00

AERODYNAMIC STABILITY DERIVATIVES
*****DISTRIBUTED FORCE COEFFICIENTS (DYNAMIC PRESSURE = 0.
REAL)

1	-0.14357547E-01
2	-0.26047353E-04
3	-0.13686501E-01
4	-0.84458037E-05
5	-0.13267461E-01
6	0.55308361E-04
7	-0.95935404E-02
8	-0.42095377E-03
9	-0.13470496E-01
10	0.15316699E-02

$$CZ = -0.63243476E-01 \quad CN = 0.47430755E-02 \quad CL = -0.33071665E-01$$

TOTAL CHORDWISE CENTER OF PRESSURE (XBAR-X0)/CBAR = 0.74997071E-01

STRIP	CLC/CAVE	LOCAL CHORDWISE CP
1	0.77331154E-01	0.25090545E-00
2	0.76935378E-01	0.25030836E-00
3	0.72594246E-01	0.24790691E-00
4	0.52207863E-01	0.27101722E-00
5	0.68613441E-01	0.18585294E-00

*****DISTRIBUTED FORCE COEFFICIENTS (DYNAMIC PRESSURE = 0.40000000E 03) REAL

1	-0.15553647E-01
2	-0.70288702E-04
3	-0.15114766E-01
4	-0.21486091E-04
5	-0.14917786E-01
6	0.54172933E-04
7	-0.11358085E-01

8	-0.42172892E-03
9	-0.15051256E-01
10	0.16281382E-02

AERODYNAMIC COEFFICIENTS

$$CZ = -0.70826732E-01 \quad CM = 0.52602834E-02 \quad CL = -0.37375409E-01$$

TOTAL CHORDWISE CENTER OF PRESSURE (XBAR-X0)/CBAR = 0.74269747E-01

TOTAL SPANWISE CENTER OF PRESSURE YBAR/S = 0.52770201E 00

STRIP	CLC/CAVE	LOCAL CHORDWISE CP
1	0.83999655E-01	0.25222339E-00
2	0.85035121E-01	0.25070975E-00
3	0.81668207E-01	0.24817766E-00
4	0.61999021E-01	0.26790049E-00
5	0.77144355E-01	0.1893320E-00

*****DISTRIBUTED FORCE COEFFICIENTS (DYNAMIC PRESSURE = 0.8000000E 03)
REAL

1	-0.17061824E-01
2	-0.12706977E-03
3	-0.16922084E-01
4	-0.38488138E-04
5	-0.17013357E-01
6	0.52667091E-04
7	-0.13610871E-01
8	-0.42118333E-03
9	-0.17049915E-01
10	0.17485712E-02

AERODYNAMIC COEFFICIENTS

$$CZ = -0.80443554E-01 \quad CM = 0.59154046E-02 \quad CL = -0.42837886E-01$$

TOTAL CHORDWISE CENTER OF PRESSURE (XBAR-X0)/CBAR = 0.73534849E-01

TOTAL SPANWISE CENTER OF PRESSURE YBAR/S = 0.53252105E 00

STRIP	CLC/CAVE	LOCAL CHORDWISE CP
1	-0.41379851E-02	0.26184864E-00
2	-0.49220639E-02	0.24625484E-00
3	-0.47957923E-02	0.24737089E-00
4	-0.40459378E-02	0.25357463E-00
5	-0.31583379E-02	0.21799854E-00

*****DISTRIBUTED FORCE COEFFICIENTS (DYNAMIC PRESSURE = 0.12000000E 04)

REAL

1	0.84211492E-03
2	0.21670499E-04
3	0.99198898E-03
4	-0.56417739E-05
5	0.10039362E-02
6	-0.46560635E-05
7	0.89774501E-03
8	0.52784889E-05
9	0.69878040E-03
10	-0.41836873E-04

AERODYNAMIC COEFFICIENTS

CZ = 0.44093797E-02 CM = -0.31463867E-03 CL = 0.23244022E-02

TOTAL CHORDWISE CENTER OF PRESSURE (XBAR-X0)/CBAR = 0.7135674E-01

TOTAL SPANWISE CENTER OF PRESSURE YBAR/S = 0.52714948E 00

STRIP	CLC/CAVE	LOCAL CHORDWISE CP
1	-0.46440070E-02	0.26254391E-00
2	-0.55412764E-02	0.24714006E-00
3	-0.54905503E-02	0.24767029E-00
4	-0.47527552E-02	0.25292267E-00
5	-0.37755375E-02	0.21815793E-00

*****DISTRIBUTED FORCE COEFFICIENTS (DYNAMIC PRESSURE = 0.
REAL

1	0.62580293E-03
2	0.13604192E-04
3	0.73171273E-03
4	-0.77137574E-05
5	0.70380675E-03
6	-0.44100925E-05
7	0.58094388E-03
8	0.56954086E-05
9	0.43050759E-03
10	-0.26081324E-04

CZ = 0.30538682E-02 CM = -0.22184324E-03 CL = 0.15615184E-02
 TOTAL CHORDWISE CENTER OF PRESSURE (XBAR-X0)/CBAR = 0.72643355E-01
 TOTAL SPANWISE CENTER OF PRESSURE YBAR/S = 0.51132476E 00

STRIP	CLC/CAVE	LOCAL CHORDWISE CP
1	-0.34376726E-02	0.26063813E-00
2	-0.40674099E-02	0.244467281E-00
3	-0.38428387E-02	0.24684721E-00
4	-0.30875752E-02	0.25485426E-00
5	-0.23242888E-02	0.21775515E-00

*****DISTRIBUTED FORCE COEFFICIENTS (DYNAMIC PRESSURE = 0.40000000E 03)
REAL

1	0.68150777E-03
2	0.15638322E-04
3	0.79858477E-03
4	-0.72253242E-05
5	0.78050370E-03
6	-0.45051783E-05
7	0.66105811E-03

8	0.56248754E-05
9	0.49821869E-03
10	-0.30087743E-04

AERODYNAMIC COEFFICIENTS

$$C2 = 0.33993179E-02 \quad CM = -0.24555183E-03 \quad CL = 0.17552938E-02$$

TOTAL CHORDWISE CENTER OF PRESSURE (XBAR-X0)/CBAR = 0.72235616E-01

TOTAL SPANWISE CENTER OF PRESSURE YBAR/S = 0.51636646E 00

STRIP	CLC/CAVE	LOCAL CHORDWISE CP
1	-0.37480972E-02	0.26121596E-00
2	-0.44458395E-02	0.24543487E-00
3	-0.42637280E-02	0.24709717E-00
4	-0.35088578E-02	0.25421855E-00
5	-0.26904077E-02	0.21786396E-00

*****DISTRIBUTED FORCE COEFFICIENTS DYNAMIC PRESSURE = 0.80000000E 03
REAL

1	0.75142628E-03
2	0.18238975E-04
3	0.88268986E-03
4	-0.65624736E-05
5	0.87742376E-03
6	-0.45895410E-05
7	0.76323235E-03
8	0.54958509E-05
9	0.58423666E-03
10	-0.35112852E-04

AERODYNAMIC COEFFICIENTS NTS

$$C2 = 0.38369058E-02 \quad CM = -0.27551733E-03 \quad CL = 0.20014707E-02$$

TOTAL CHORDWISE CENTER OF PRESSURE (XBAR-X0)/CBAR = 0.71807165E-01

TOTAL SPANWISE CENTER OF PRESSURE YBAR/S = 0.52163664E 00

STRIP	CLC/CAVE	LOCAL CHORDWISE CP
1	0.92413411E-01	0.25369627E-00
2	0.95284114E-01	0.25113463E-00
3	0.93190604E-01	0.24844737E-00
4	0.73852917E-01	0.26500790E-00
5	0.87938758E-01	0.19286216E-00

*****DISTRIBUTED FORCE COEFFICIENTS (DYNAMIC PRESSURE = 0.12000000E 04)

REAL	
1	-0.19026747E-01
2	-0.20222989E-03
3	-0.19283674E-01
4	-0.61302655E-04
5	-0.19760993E-01
6	0.50624304E-04
7	-0.16578963E-01
8	-0.41865196E-03
9	-0.19659936E-01
10	0.19040231E-02

AERODYNAMIC COEFFICIENTS

CZ = -0.93037650E-01	CM = 0.67724387E-02	CL = -0.49996965E-01
TOTAL CHORDWISE CENTER OF PRESSURE (XBAR-X0)/CBAR = 0.72792295E-01		
TOTAL SPANWISE CENTER OF PRESSURE YBAR/S = 0.53738306E 00		

STRIP	CLC/CAVE	LOCAL CHORDWISE CP
1	0.10338160E-00	0.25525846E-00
2	0.10867964E-00	0.25158446E-00
3	0.10829873E-00	0.24871579E-00
4	0.89461129E-01	0.26231502E-00
5	0.10204548E-00	0.19638340E-00

SECTION V

PROCESSING INFORMATION

A. Operation

FORTRAN II MONITOR system

B. Estimated Machine Time

Because of the number of variables involved such as options, order of system, number of dynamic pressures, etc., it is not possible to give a practical method of estimating machine time. When the data are appropriate, considerable time may be saved by performing as many options as possible in one machine pass. Also, complete but independent data decks may be stacked to save program read-in time.

C. Machine Components Used

About 26,000 core storages

Standard FORTRAN input tape (NTAPE2)

Standard FORTRAN output print tape (NTAPE3)

Four utility tapes (NTAPE4, NTAPE5, NTAPE6, NTAPE8)

SECTION VI

PROGRAM NOTES

A. Subroutines Used

In addition to the main program (page 77) the following subprograms were used.

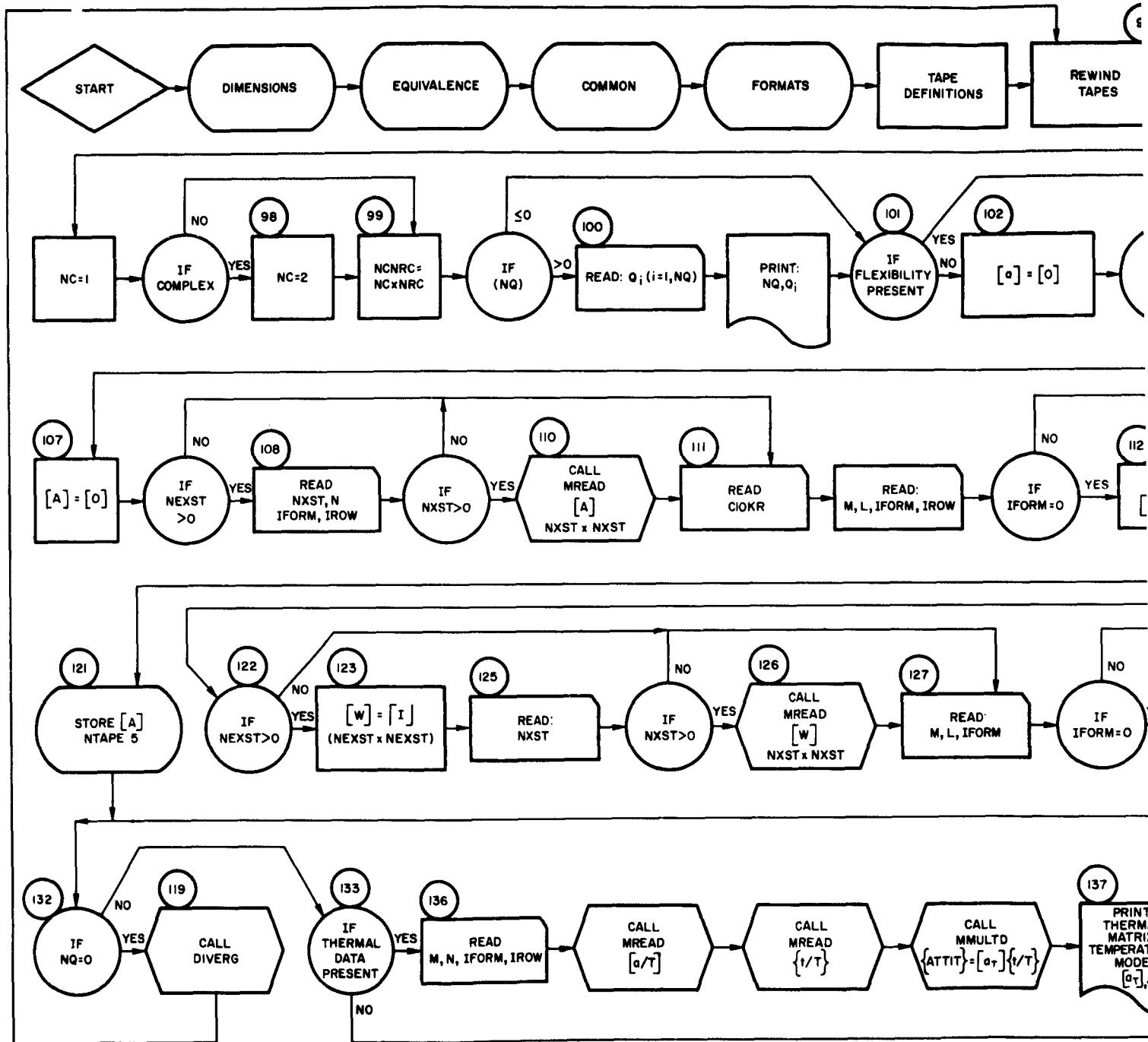
1. MPRINT, prints matrix in matrix format (page 91).
2. MMULTD, computes the product $[C]$ of the two matrices $[A]$ and $[B]$ (page 95).
3. MREAD, reads a matrix in either column binary or FORTRAN format (page 98).
4. BINRD, reads column binary cards (page 103).
5. RDLN, reads and prints title card (page 113).
6. MNVRSX, computes the inverse of a complex matrix (page 115).
7. INVERS, computes the inverse of a real matrix (page 118).
8. SWEEPX, computes true mode and sweeps it from the related matrix (page 123).
9. CENTER, computes the aerodynamic coefficients, centers of pressure, and spanwise loadings (page 128).
10. LOADS, computes the three loads options and the structural loads suboption (page 133).
11. DERIV, computes the flexible load coefficients used in the derivative options (page 143).
12. MITER, matrix iteration (page 149).
13. NPNRMX, vector normalization (page 160).
14. DIVERG, divergent pressure calculations (page 165).

B. Generalized Tapes

Input, print, and utility tapes in this coding are defined as logical units 2, 3, 5, 6, 7, and 8; however, these may be altered by placing the desired units on symbolic cards HMO3O827 through HMO3O832 in the main program.

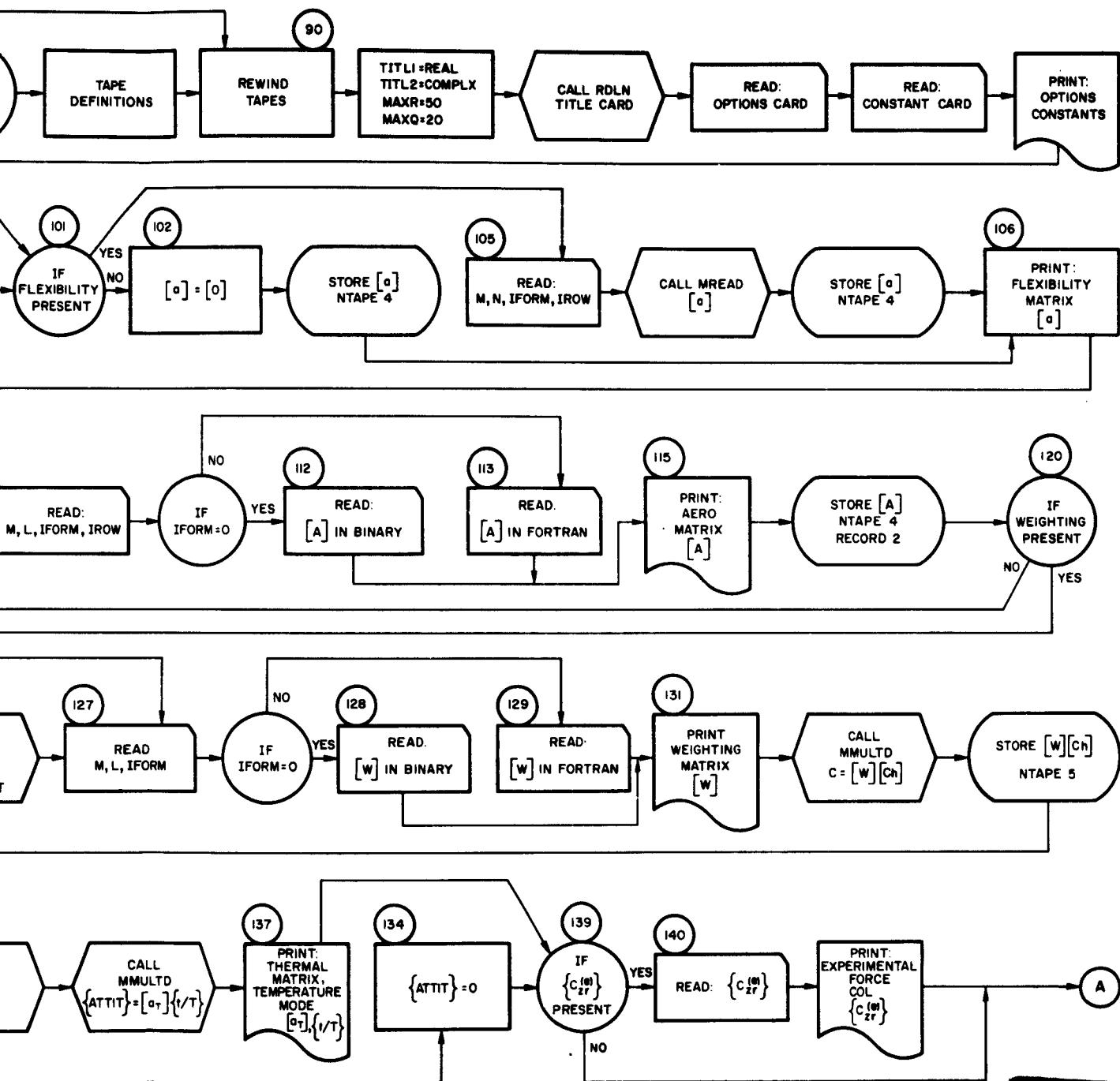
SECTION VII
FLOW DIAGRAMS

FLOW DIAGRAM - MAIN PROGRAM

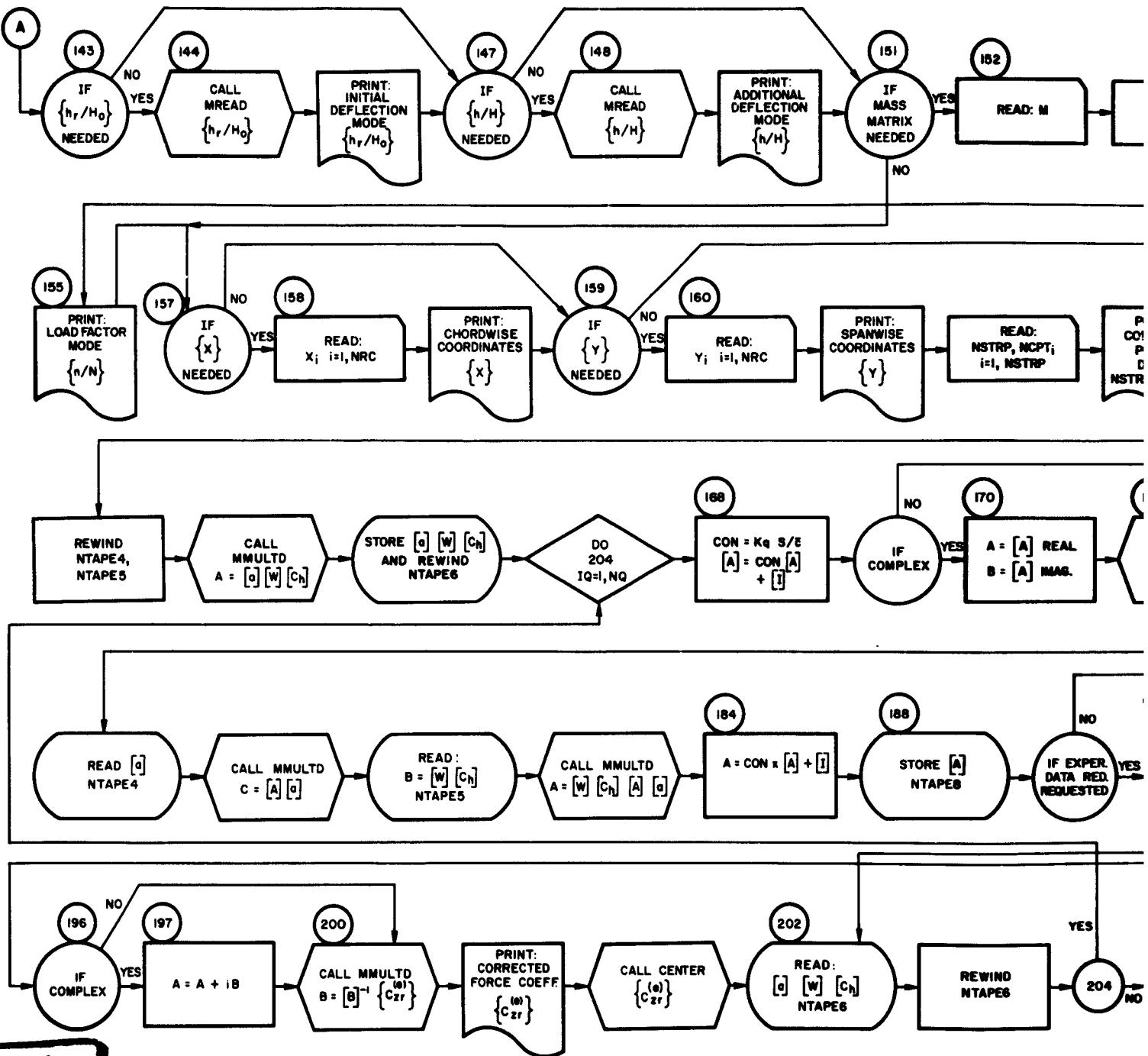


1

GRAM - MAIN PROGRAM

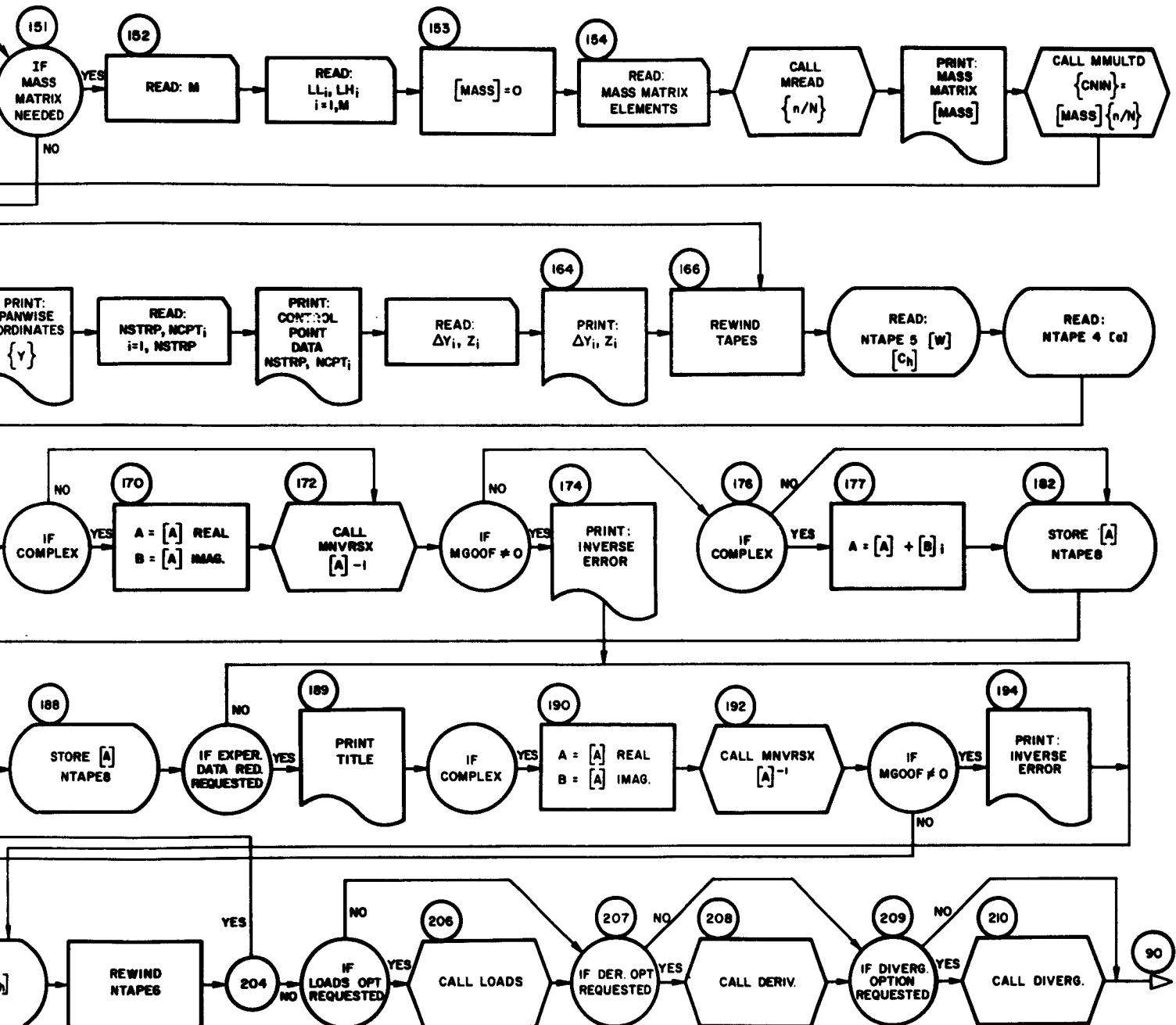


FLOW DIAGRAM — MAIN PROGRAM

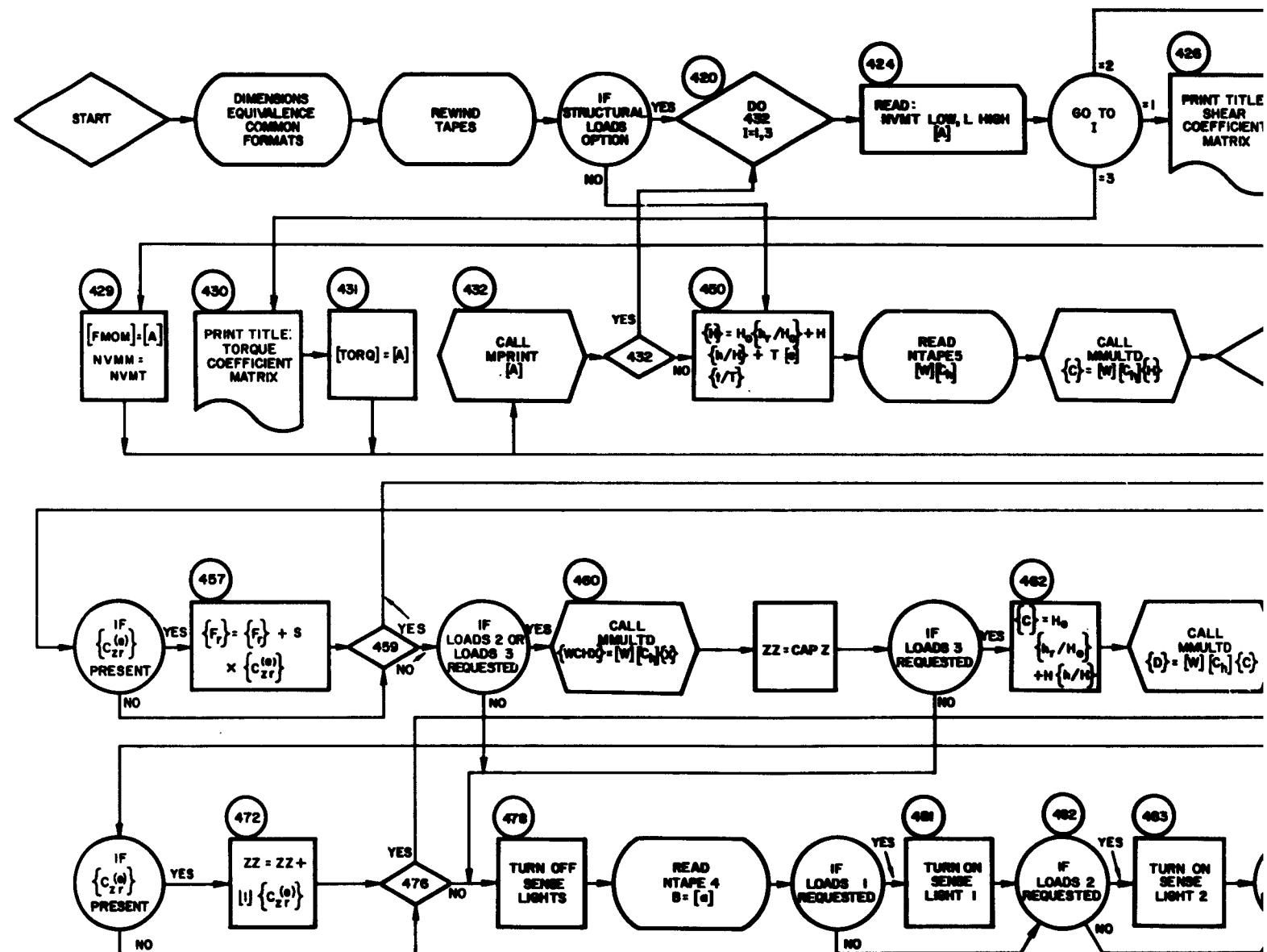


1

RAM — MAIN PROGRAM (CONTINUED)

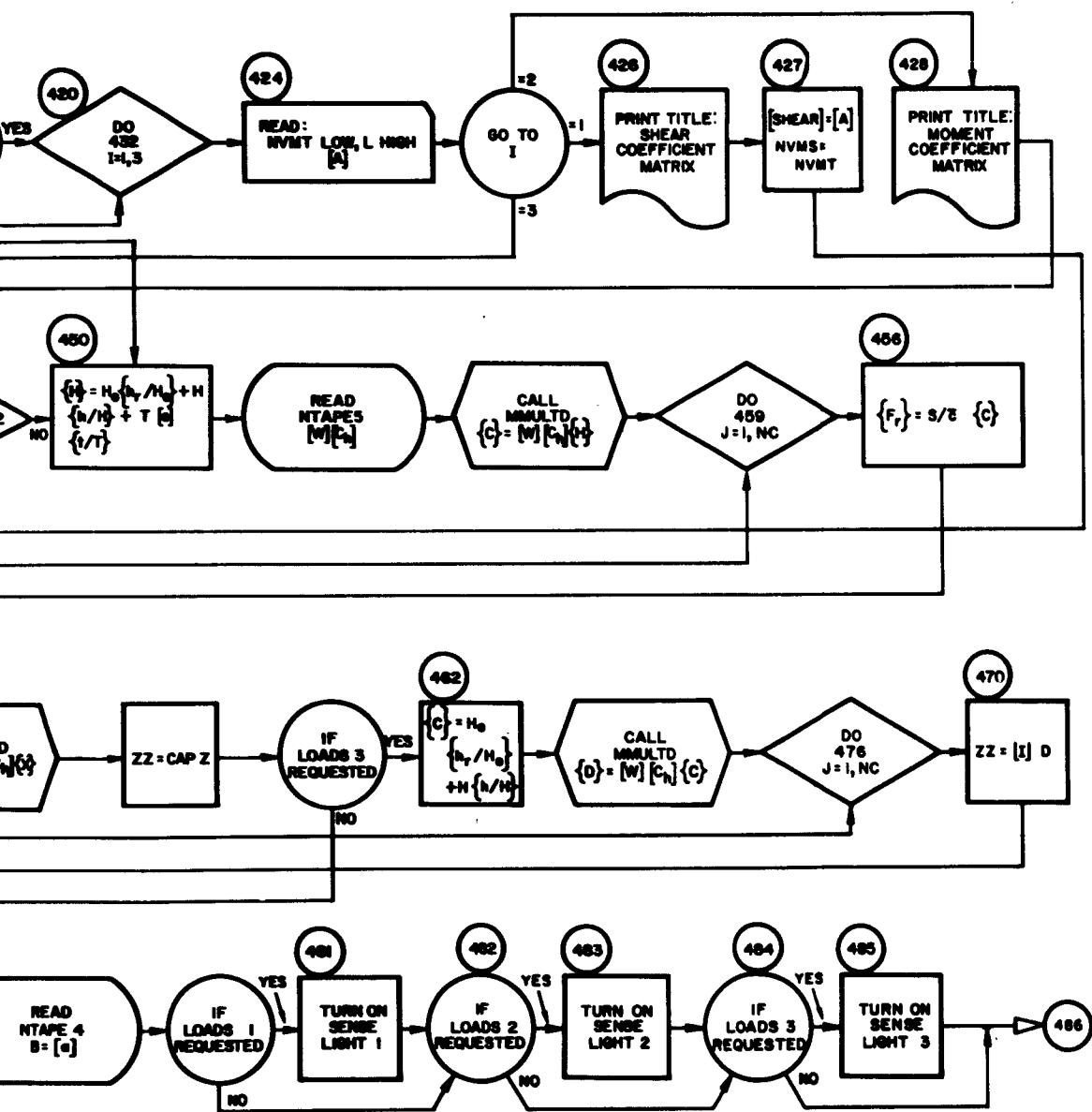


FLOW DIAGRAM - LOADS SUBROUTINE





BRAM - LOADS SUBROUTINE



FLOW DIAGRAM - LOADS SUBROUTINE

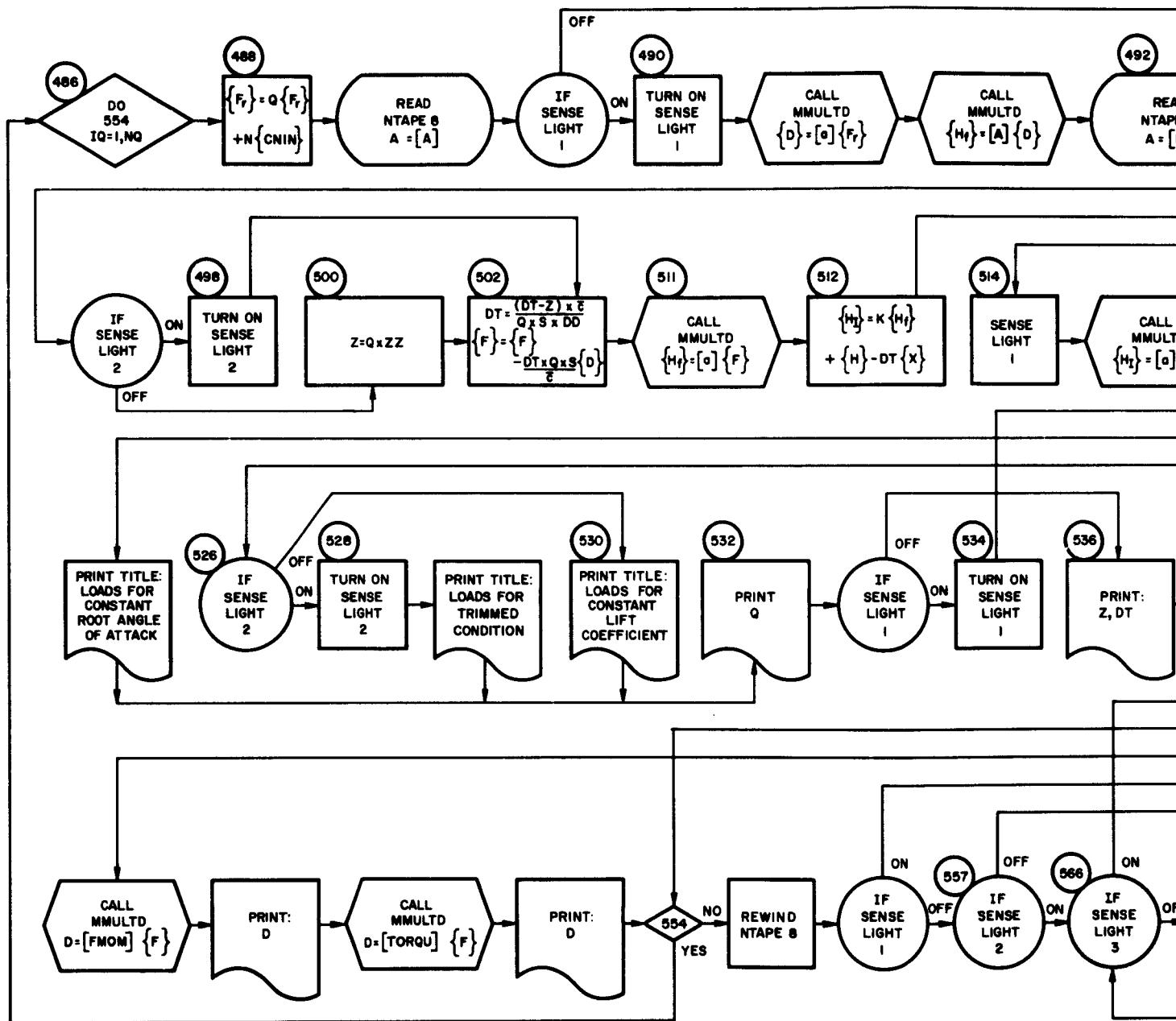
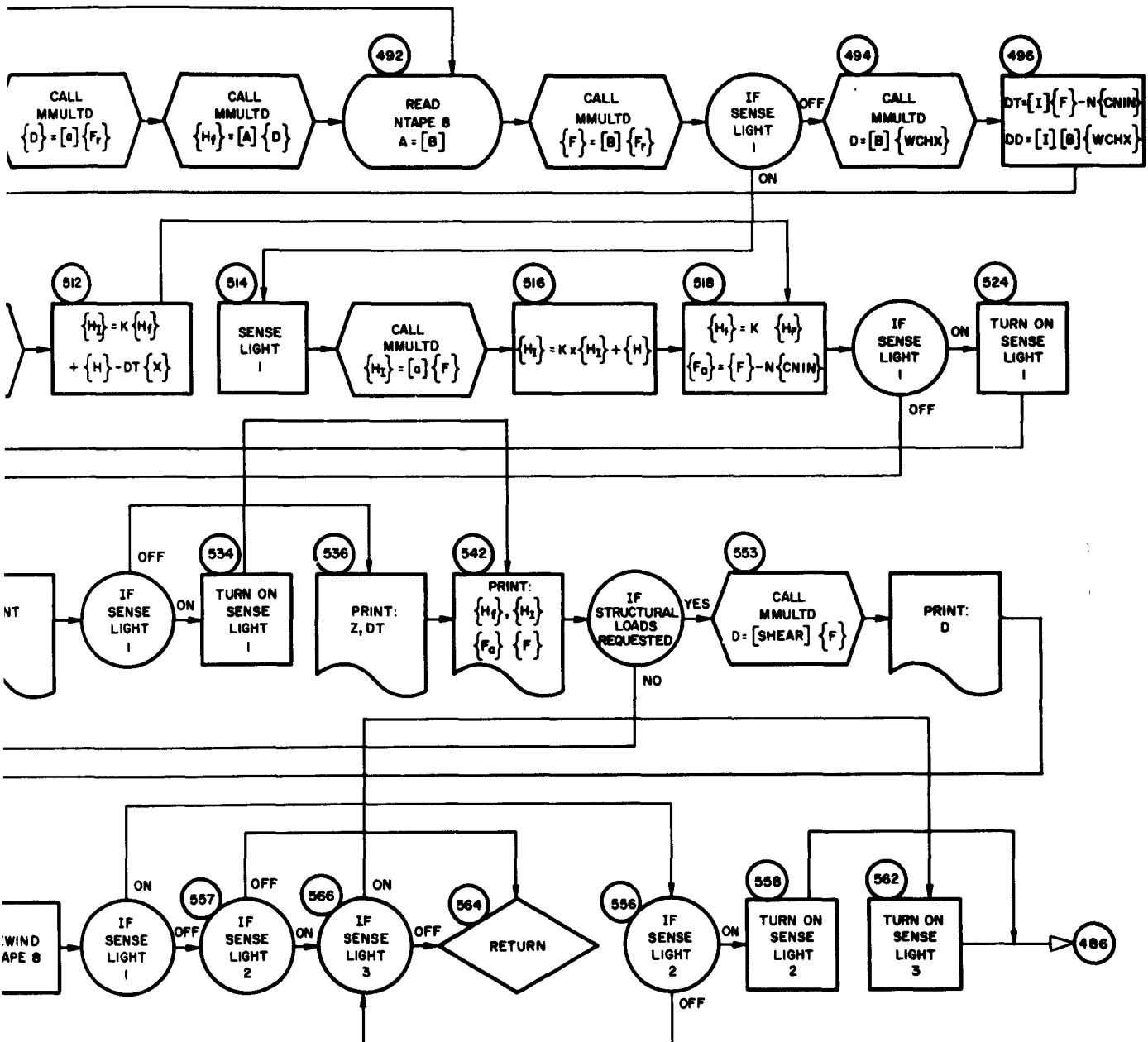
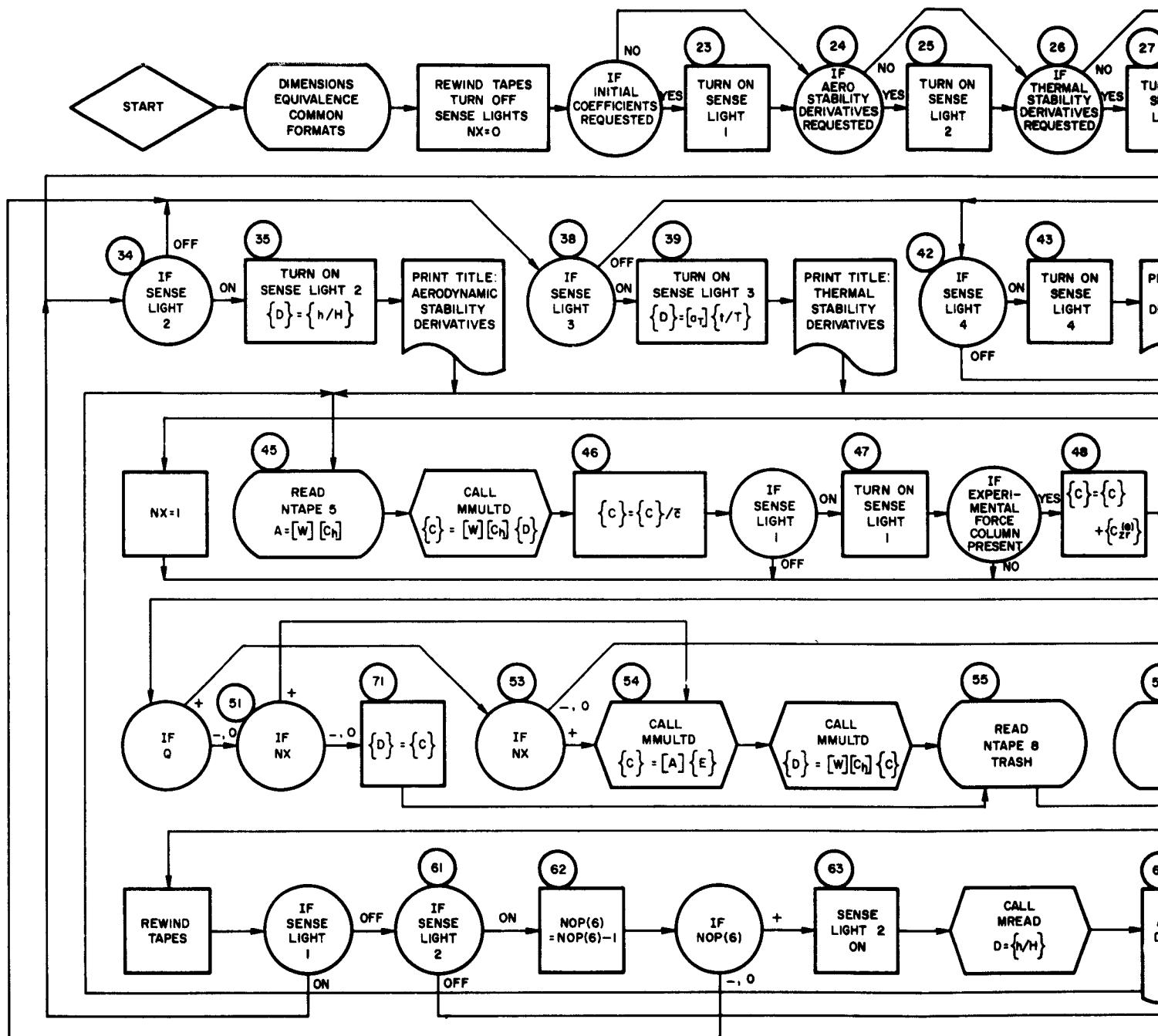


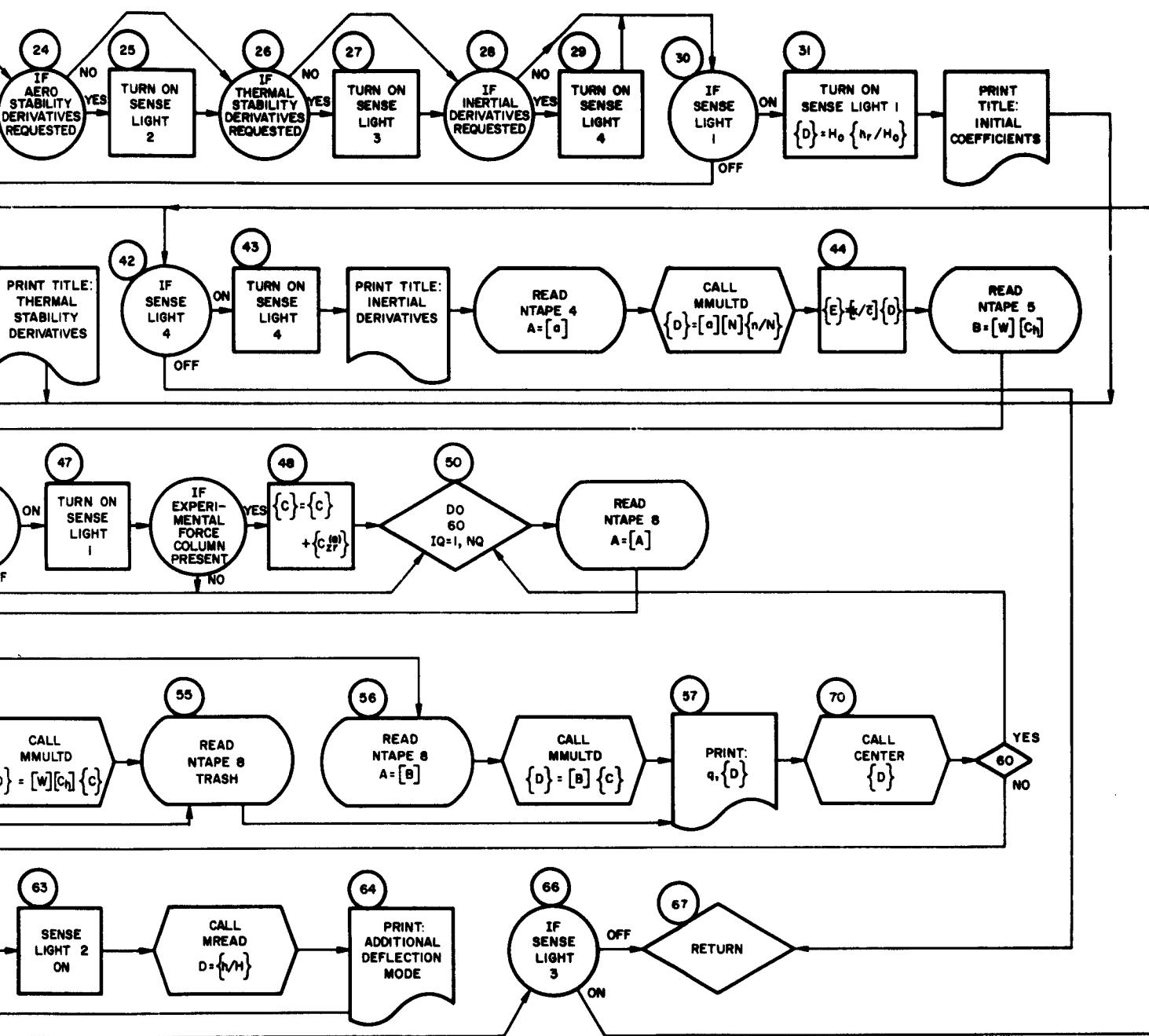
DIAGRAM - LOADS SUBROUTINE



FLOW DIAGRAM — DERIVATIVES SUB



GRAM - DERIVATIVES SUBROUTINE



SECTION VIII

SYMBOLIC LISTING

Some of the program FORTRAN symbols are defined below.

<u>FORTRAN Symbols</u>	<u>Definitions</u>
A(I,J), B(I,J), C(I,J)	Elements of matrix "working" arrays; also elements of [a], [C _h], and [W]
ATTIT(I,J)	Element of column matrix representing the product [a _T]{t/T}
C1OKR	1/k _r
CAPH	H
CAPHO	H _o
CAPN	N
CAPS	S (reference area)
CAPT	T
CAPXO	x _o
CAPZ	Z
CBAR	c̄
CNIN(I,J)	Element of column matrix representing the product [M]{n/N}
CZRE(I,J)	Element of experimental force column matrix
DELY(J)	Δy _j (width of strip j)
F(I,J)	Element of total force distribution column
FA(I,J)	Element of final aerodynamic force distribution column
FLEXK	K
FMOM(J,K)	Element in load coefficient matrix [M/F]
FR(I,J)	Element of rigid force distribution column
HADD(I,J)	Element of additional deflection mode column
HR(I,J)	Element of initial deflection mode column

<u>FORTRAN Symbols</u>	<u>Definitions</u>
IFORM	IFORM = 1 if matrix is in FORTRAN format; = 0 if matrix is in column binary format
IROW	IROW = 1 if matrix is input by rows; = 0 if matrix is input by columns
L	Number of strips (partitions) in the surface aerodynamic matrix
LH(K)	Row number of last nonzero element in column k of mass matrix
LHIGH(J)	Column number of last nonzero element in row j of [V/F], [M/F], or [T/F]
LL(k)	Row number of first nonzero element in column k of mass matrix
LOW(J)	Column number of first nonzero element in row j of [V/F], [M/F], or [T/F]
NCPT(J)	Number of control points for strip j
NEXT	Number of external stores reserved
NOP(I)	Option i, Field i of control card (data Item 2)
NQ	Number of dynamic pressures read in
NRC	Order of current case
NSTRP	Number of surface strips used for derivatives options
NVMT	Number of rows in [V/F], [M/F], or [T/F]
Q(I)	(ith) dynamic pressure
SHEAR(J,K)	Element in load coefficient matrix [V/F]
SMALS	s
TCCP	Chordwise center of pressure
TORQU(J,K)	Element in load coefficient matrix [T/F]
TSCP	Spanwise center of pressure
X(I)	Element in chordwise coordinate matrix
Y(I)	Element in spanwise coordinate matrix
ZI(I,J)	Location of <u>j</u> th control point for strip i

The symbolic listing of the program is shown on the following pages.

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DIMENSION NOP(24), Q(10), X(50), Y(50), ATT1(50,2), CZRE(50,2), HMD30771
1      HADD(50,2), LL(50), LH(50), CNIN(50,2), HR(50,2), HMD30772
2      NCPT(50), DELY(50), Z(50,10), HMD30773
DIMENSION A(50,100), B(50,100), C(50,100) HMD30774
HMD30775
EQUIVALENCE (NOP(14),NQ), (NOP(113),NEXST), (LH,X), (LL,Y),
1      (NOP(17),NRC), (NOP(23),TITL1), (NOP(24),TITL2) HMD30776
HMD30777
COMMON NOP, X, Y, NTAPE2, NTAPE3, NTAPE4, NTAPE5, NTAPE6, NTAPE8, HMD30779
1      CBAR, FLEX, CAPS, CAPH, CAPT, CAPN, SMALS, CAPXO, C10KRMHMD30780
2      ,CAPZ, CAPHO, Q, MAXR, ATT1, CZRE, CNIN, HR, HADD, HMD30781
3      ,NSTRP, NCPT, DELY, Z1, MAXQ, NC, MCNRC, A, B, C, I, K1, HMD30782
4      K, L, MGDOF, N, N, NXST, T, CON, IFORM, IRON, HMD30783
HMD30784
1 FORMAT ( 18I4 )
2 FORMAT ( 6E12.8 )
3 FORMAT ( 1H0 43X, 13HCONTROL ITEMS / 1H 12X, 5H (1)= 112,
1      6H (2)= 112, 6H (3)= 112, 6H (4)= 112, 6H (5)= 112, HMD30786
2      6H (6)= 112, 6H (7)= 112, 6H (8)= 112, 6H (9)= 112, HMD30787
3      / 1H 12X, 5H(10)= 112, 6H (11)= 112, 6H (12)= 112,
4      6H (13)= 112, 6H (14)= 112, 6H (15)= 112, 6H (16)= 112, HMD30788
5      6H (17)= 112, 6H (18)= 112, / 1H0 11X, 4HCBAR 15X,
6      10HNORM CONST 13X, 4HCAPS 20X, 1H2 18X, SHREF H / 1H HMD30789
7      SE21.8 / 1H0 11X, SHREF T 16X, SHREF N 17X, 3HSMS 18X, HMD30790
8      2HX0 16X, 6HREF HO / 1H 5E21.8 ) HMD30791
4 FORMAT ( 1H0 34X, 114, 18H DYNAMIC PRESSURES / (1H 6E16.8) )
5 FORMAT ( 1H0 46X, 19H FLEXIBILITY MATRIX ) HMD30792
6 FORMAT ( 1H 36X, 1A6, // (1H 24X, 116; 3X, 1E16.8 ) )
7 FORMAT ( 1H 36X, 1A6, // (1H 15X, 116, 3X, 2E16.8, 1H1 ) )
8 FORMAT ( 1H0 41X, 36H AERODYNAMIC INFLUENCE COEFFICIENTS 5X,
1      1A6,3X, 6H1/KR = 1E18.8 / )
9 FORMAT ( 1H0 46X, 17H WEIGHTING MATRIX )
10 FORMAT ( 1H0 48X, 32H THERMAL INFLUENCE COEFFICIENTS )
11 FORMAT ( 1H0 39X, 18H TEMPERATURE MODE / )
12 FORMAT ( 1H0 32X, 32H EXPERIMENTAL FORCE COEFFICIENTS / )
13 FORMAT ( 1H0 25X, 39H ADDITIONAL DEFLECTION MODE (H/REF H) / )
14 FORMAT ( 1H0 29X, 36H INITIAL DEFLECTION MODE (HR/REF HD) / )
15 FORMAT ( 1H0 48X, 12H MASS MATRIX )
16 FORMAT ( 1H0 39X, 18H LOAD FACTOR MODE / )

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17 FORMAT ( 1H) 36X, 22H CHORDWISE COORDINATES / ) HMO3C8C9
18 FORMAT ( 1H) 36X, 21H SPANNWISE COORDINATES / ) HMO30810
19 FORMAT ( 1H) 25X, 33H INPUT DATA FOR LOAD DISTRIBUTION HMO3C811
1 13H CALCULATIONS / 1H0 34X, 1I3, 7H STRIPS / 1H0 36X, HMO30812
2 22H STRIP CONTROL POINTS / (1H 26X, 2I13 ) ) HMO3U813
20 FORMAT ( 1H) 4X, 19H STRIP DELTA Y(I) 6X, 17H CHORDWISE CONTROL HMO30814
1 32H POINT LOCATIONS (PERCENT CHORD) ) HMO3C815
21 FORMAT ( 1H 117, 1E13.8,2X, 5E16.8 / (1H 27X, 5E16.8) ) HMO30816
22 FORMAT ( 1H) 1DX, 38H ERROR RETURN FROM INVERSE SUBROUTINE. ) HMO3U817
23 FORMAT (49H)***CORRECTED EXPERIMENTAL FORCE COEFFICIENTS HMO3U818
1 21H (DYNAMIC PRESSURE = 1E16.8, 1H) / (1H 6E16.8) , HMO3U819
24 FORMAT ( 1H1 ) HMO3U820
C NTAPE2 = I'INPUT TAPE HMO3C821
C NTAPE3 = O'PUT PRINT TAPE HMO3C822
C NTAPE4 = / HMC3U823
C NTAPE5 = / ARE UTILITY TAPES. HMO30824
C NTAPE6 = / HMO30825
C NTAPE8 = / HMO30826
NTAPE2 = 2 HMO3C827
NTAPE3 = 3 HMO30828
NTAPE4 = 5 HMO30829
NTAPE5 = 6 HMO30830
NTAPE6 = 7 HMU3U831
NTAPE8 = 8 HMC30832
HMO30833
HMO3C834
HMO30835
HMO30836
HMO30837
HMO3C838
HMO3U839
HMO30840
HMO30841
HMO3U842
HMO3U843
HMO3C844
HMO3U845
HMO30846
B TITL1=6C6C51252143
B TITL2=234644474367
MAXR=5
MAXQ=2
C READ IN TITLE CARD, OPTIONS CARD AND CONSTANTS CARDS AND PRINT.
CALL RDLN (NTAPE2*NTAPE3,1)
READ INPUT TAPE NTAPE2, 1, (NOP(1), I=1,18)
```

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READ INPUT TAPE NTAPE2, 2, CBAR, FLEXK, CAPS, CAPZ, CAPH, CAPT, HMO30847
1   WRITE OUTPUT TAPE NTAPE3, 3, (NQ(I), I=1,18), CBAR, FLEXK, CAPS, HMO30848
1   CAPZ, CAPH, CAPT, CAPN, SMALS, CAPXO, HMO30849
1   CAPPHD, HMO30850
2
C FIRST DETERMINE IF REAL OR COMPLEX.
NC=1
IF (NQ(1)) 98,99,98
98 NC=2
99 NCNRC=NC+NRC
HMO30851
HMO30852
HMO30853
HMO30854
HMO30855
HMO30856
HMO30857
HMO30858
HMO30859
HMO30860
HMO30861
HMO30862
HMO30863
HMO30864
HMO30865
HMO30866
HMO30867
HMO30868
HMO30869
HMO30870
HMO30871
HMO30872
HMO30873
HMO30874
HMO30875
HMO30876
HMO30877
HMO30878
HMO30879
HMO30880
HMO30881
HMO30882
HMO30883
HMO30884

C IF ENTERING DYNAMIC PRESSURES, READ AND PRINT.
IF ( NQ ) 101,101,100
100 READ INPUT TAPE NTAPE2, 2, (Q(I), I=1,NQ)
WRITE OUTPUT TAPE NTAPE3, 4, NQ, (Q(I), I=1,NQ)
HMO30861
HMO30862
HMO30863
HMO30864
HMO30865
HMO30866
HMO30867
HMO30868
HMO30869
HMO30870
HMO30871
HMO30872
HMO30873
HMO30874
HMO30875
HMO30876
HMO30877
HMO30878
HMO30879
HMO30880
HMO30881
HMO30882
HMO30883
HMO30884

C READ FLEXIBILITY MATRIX, IF PRESENT, PRINT AND STORE ON TAPE 4.
101 IF (NQ(18)) 102,102,105
102 DO 104 I=1,NRC
    DO 103 J=1,NRC
        A(J,I)=0.
103 A(J,I+1)=0.
104 A(I,I)=0.
        WRITE TAPE NTAPE4, ((A(I,J), J=1, NRC), I=1, NRC)
        GOTO 106
105 READ INPUT TAPE NTAPE2, 1, M, N, IFORM, IRW
CALL MREAD (A, M, N, IFORM, IRW, O, 1, B, MAXR, NTAPE2, NTAPE3)
        WRITE TAPE NTAPE4, ((A(I,J), J=1,N), I=1,M)
106 WRITE OUTPUT TAPE NTAPE3, 5
        CALL MPRINT (A, NRC, NRC, MAXR, NTAPE3)
C READ AERODYNAMIC EXTERNAL STORES, IF PRESENT, THEN AERO MATRIX.
C           PRINT AND STORE ON TAPE 4, RECORD 2.
        DO 107 I=1,NRC
            DO 107 J=1,NCNRC
                A(I,J)=0.
107 IF (INEXTI) 111,111,108

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```
108 CONTINUE  
      READ INPUT TAPE NTAPE2, 1, NXST, N, IFORM, IRW  
      IF (NXST) 111,110  
110 N=NXST+NC  
      CALL MREAD (A,NXST,N, IFORM,IRW, 0,0, B, MAXR, NTAPE2,NTAPE3)  
  
111 READ INPUT TAPE NTAPE2, 2, C10KR  
      READ INPUT TAPE NTAPE2, 1, M, L, IFORM, IRW  
      K=NXST+1  
      IF ((IFORM)) 113,112,113  
112 K1=NC*K-NC+1  
      N=NC*M  
      CALL MREAD (A(K,K1), M, N, 0, 0, 0, 1, B, MAXR, NTAPE2, NTAPE3)  
      GOTO 115  
  
113 DO 114 I=1,L  
      READ INPUT TAPE NTAPE2, 1, M  
      N=NC*M  
      K1=NC*K-NC+1  
      CALL MREAD (A(K,K1),M,N, 1,IRW,0,0,B, MAXR, NTAPE2, NTAPE3)  
114 K=K+M  
  
115 GOTO (116,117),NC  
116 T=TITL1  
      GOTO 118  
117 T=TITL2  
118 WRITE OUTPUT TAPE NTAPE3, 8, T, C10KR  
      CALL MPRINT(A, NRC, NCNRC, MAXR, NTAPE3)  
      WRITE TAPE NTAPE4, ((A(I,J),J=1,NCNRC),I=1,NRC)  
  
C IF WEIGHTING MATRIX, READ, PRINT AND STORE (W) (CH) ON TAPE 5.  
C OTHERWISE, STORE (CH) ON TAPE 5.  
120 IF (NDP(10)) 122,121,122  
121 WRITE TAPE NTAPE5, ((A(I,J),J=1,NCNRC),I=1,NRC)  
      GOTO 132
```

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```

122 IF (NEXST) 127,127,123
123 DO 125 I=1,NEXST
      DO 124 J=1,NEXST
124   B(I,J)=0.
125   B(I,I)=1.

      READ INPUT TAPE NTAPE2, 1, NXST, K, IFORM, IRW
      IF (NXST) 127,127,126
126 CALL MREAD (B,NXST,NXST, IFORM,IRW, 0,0,C, MAXR,NTAPE3)

127 K=NEXST+1
      READ INPUT TAPE NTAPE2, 1, M, L, IFORM, IRW
      IF (IFORM) 129,128,129
128 CALL MREAD (B(K,K), M, M, 0, 0, 1, C, MAXR, NTAPE2, NTAPE3)
      GOTO 131

129 DO 130 I=1,L
      READ INPUT TAPE NTAPE2, 1, M
      CALL MREAD (B(I,K),M,M,1,IRW,0,0,C,MAXR,NTAPE2,NTAPE3)
130 K=K+M
      WRITE OUTPUT TAPE NTAPE3, 9
      CALL MPRINT(B,NRC,NRC,MAXR,NTAPE3)
      CALL MMULD(B,0,A,NOP(7),C,NRC,NRC,MAXR,MAXR,MAXR)
      WRITE TAPE NTAPES, ((C(I,J),J=1,NCNRC),I=1,NRC)
      C IF DIVERGENCE OPTION ONLY, GO AND DO.
      132 IF ( NQ ) 133,119,133
      119 CALL DIVERG
      GOTO 90

      C IF THERMAL DATA PRESENT, READ,PRINT AND MULTIPLY MATRIX BY MODE AND
      C STORE AT ATTIT.
      133 IF ( NOP(111) ) 136,134,136
      134 DO 135 I=1,NC
            DO 135 J=1,NRC
            ATTIT(J,I)=0.
      135 GOTO 139

```

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```
136 READ INPUT TAPE NTAPE2, 1, M, N, IFORM, IRW  
    CALL MREAD (A, M, IFORM, IRW, 0, 1, B, MAXR, NTAPE2, NTAPE3) HMO30962  
    CALL MREAD (B, N, NC, 1, 0, 0, C, MAXR, NTAPE2, NTAPE3) HMO30963  
    CALL MMULTD(A, O, B, NOP(7)), ATIT, NRC, NRC, 1, MAXR, MAXR) HMO30964  
    WRITE OUTPUT TAPE NTAPE3, 10 HMO30965  
    CALL MPRTN(A, NRC, MAXR, NTAPE3) HMO30966  
    WRITE OUTPUT TAPE NTAPE3, 11 HMO30967  
    IF (NOP(7))138,137,138 HMO30968  
137 WRITE OUTPUT TAPE NTAPE3, 6, TITL1, (I,B(I,I),I=1,NRC) HMO30969  
    GOTO 139 HMO30970  
138 WRITE OUTPUT TAPE NTAPE3, 7, TITL2, (I,(B(I,J),J=1,NC),I=1,NRC) HMO30971  
C IF EXPERIMENTAL FORCE COLUMN PRESENT, READ, PRINT, STORE AT C2RE.  
139 IF (NOP(12)) 140,143,140 HMO30972  
140 CALL MREAD (CZRE,NRC,NC,1,0,0,B,MAXR,NTAPE2,NTAPE3) HMO30973  
    WRITE OUTPUT TAPE NTAPE3, 12 HMO30974  
    IF (NOP(7)) 142,141,142 HMO30975  
141 WRITE OUTPUT TAPE NTAPE3, 6, TITL1, (I,CZRE(I,1),I=1,NRC) HMO30976  
    GOTO 143 HMO30977  
142 WRITE OUTPUT TAPE NTAPE3, 7, TITL2, (I,(CZRE(I,J),J=1,NC),I=1,  
    2, NRC) HMO30978  
C READ INITIAL DEFLECTION MODE FOR OPTIONS REQUIRING IT, IF ANY.  
143 IF (NOP(1)+NOP(2)+NOP(3)+NOP(5)) 147,147,144 HMO30979  
144 WRITE OUTPUT TAPE NTAPE3, 14 HMO30980  
    CALL MREAD (HR, NRC, NC, 1, 0, 0, B, MAXR, NTAPE2, NTAPE3) HMO30981  
    IF (NOP(7)) 146,145,146 HMO30982  
145 WRITE OUTPUT TAPE NTAPE3, 6, TITL1, (I,HR(I,1),I=1,NRC) HMO30983  
    GOTO 147 HMO30984  
146 WRITE OUTPUT TAPE NTAPE3, 7, TITL2, (I,(HR(I,J),J=1,NC),I=1,NRC) HMO30985  
C READ ADDITIONAL DEFLECTION MODE FOR OPTIONS REQUIRING IT, IF ANY.  
147 IF (NOP(1)+NOP(2)+NOP(3)+NOP(6)) 151,151,148 HMO30986  
148 WRITE OUTPUT TAPE NTAPE3, 13 HMO30987  
    CALL MREAD (HADD, NRC, NC, 1, 0, 0, B, MAXR, NTAPE2, NTAPE3) HMO30988  
    IF (NOP(7)) 150,149,150 HMO30989  
149 WRITE OUTPUT TAPE NTAPE3, 6, TITL1, (I, ADD(I,1),I=1,NRC) HMO30990  
    GOTO 151 HMO30991  
HMO30992  
HMO30993  
HMO30994  
HMO30995  
HMO30996  
HMO30997  
HMO30998  
HMO30999
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150 WRITE OUTPUT TAPE NTAPE3, 7, TITL2, ((I,(HADD(I,J),J=1,NR),I=1,
NRC)
1
C READ MASS MATRIX, IF NEEDED.
151 IF (NOP(1)+NOP(2)+NOP(3)+NOP(9)) 157,157,152
152 READ INPUT TAPE NTAPE2, 1, M
    READ INPUT TAPE NTAPE2, 1, ((LL(K),LH(K)),K=1,M)
DO 153 I=1,NRC
    DO 153 J=1,NRC
        A(I,J)=0.
    DO 154 I=1,M
        K=LL(I)
        L=LH(I)
154    READ INPUT TAPE NTAPE2, 2, (A(J,I),J=K,L)
        WRITE OUTPUT TAPE NTAPE3, 15
        CALL MPRINT (A, NRC, NRC, MAXR, NTAPE3)
C READ LOAD FACTOR MODE (N/N) AND COMPUTE (M)*(N/N) STORED AT CN1N
CALL MREAD (B, NRC, NC, 1, 0, 0, 0, C, MAXR, NTAPE2, NTAPE3)
CALL MMULTD(A,0,B NOP(7),CN1N,NRC,NRC,1,MAXR,MAXR)
WRITE OUTPUT TAPE NTAPE3, 16
IF (NOP(17)) 156,155,156
155 WRITE OUTPUT TAPE NTAPE3, 6, TITL1, ((B(I,1),I=1,NRC)
GOTO 157
156 WRITE OUTPUT TAPE NTAPE3, 7, TITL2, ((B(I,J),J=1,NC),I=1,NRC)
C READ IN (X) COORDINATES
157 IF (NOP(12)+NOP(3)+NOP(5)+NOP(6)+NOP(8)+NOP(9)+NOP(15)) 159,159,158HM031027
158 READ INPUT TAPE NTAPE2, 2,(X(I),I=1,NRC)
    WRITE OUTPUT TAPE NTAPE3, 17
    WRITE OUTPUT TAPE NTAPE3, 6, TITL1, ((X(I),I=1,NRC)
C READ IN (Y) COORDINATES
159 IF (NOP(5)+NOP(6)+NOP(8)+NOP(9)+NOP(15)) 166,166,160
160 READ INPUT TAPE NTAPE2, 2,(Y(I),I=1,NRC)
    WRITE OUTPUT TAPE NTAPE3, 18
    WRITE OUTPUT TAPE NTAPE3, 6, TITL1, ((Y(I),I=1,NRC)
HM031036
HM031035
HM031034
HM031033
HM031032
HM031031
HM031029
HM031028
HM031027
HM031026
HM031025
HM031024
HM031023
HM031022
HM031021
HM031020
HM031019
HM031018
HM031017
HM031016
HM031015
HM031014
HM031013
HM031012
HM031011
HM031010
HM031009
HM031008
HM031007
HM031006
HM031005
HM031004
HM031003
HM031002
HM031001
HM031000

```

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```
C READ IN NUMBER OF STRIPS, AND CONTROL POINTS PER STRIP.  
READ INPUT TAPE NTAPE2, 1, NSTRP, (NCPT(1), I=1,NSTRP)  
WRITE OUTPUT TAPE NTAPE3, 19, NSTRP, (I, NCPT(I), I=1,NSTRP)  
WRITE OUTPUT TAPE NTAPE3, 20  
DO 164 I=1,NSTRP  
  M=NCPT(I)  
    READ INPUT TAPE NTAPE2, 2, (DELY(I), (ZI(I,J), J=1,M))  
164   WRITE OUTPUT TAPE NTAPE3, 21, (I, DELY(I), (ZI(I,J), J=1,M ))  
  
C COMPUTE.....  
C   (A) = ( (1)-KQS/CBAR * (FLEXIBILITY)*(WEIGHTING)*(AERODYNAMIC) )  
C                                INVERSE  
C  
C   (B) = ( (1)+KQS/CBAR * (WEIGHTING)*(AERODYNAMIC)*(A)*(FLEXIBILITY)  
C  
C   STORE (A) AS RECORD NUMBER 1 AND (B) AS RECORD NUMBER 2 ON NTAPE8  
C   BY ROWS.          REAL OR COMPLEX.  
C  
166 REWIND NTAPE4  
REWIND NTAPES  
REWIND NTAPE6  
REWIND NTAPE8  
  
C READ AERO DATA, (W)(CH) FROM NTAPES, AND FLEX., (A) FROM NTAPE4  
READ TAPE NTAPES, ((C(I,J), J=1,NCNRC), I=1,NRC)  
READ TAPE NTAPE4, ((B(I,J), J=1,NRC), I=1,NRC)  
REWIND NTAPES  
REWIND NTAPE4  
CALL MMULT1B,O,C,NOP(7),A,NRC,NRC,NRC,MAXR,MAXR  
WRITE TAPE NTAPE6, ((A(I,J), J=1,NCNRC), I=1,NRC)  
REWIND NTAPE6  
  
DO 204 IQ=1,NQ  
  C EXPECT ( (A)*(W)*(CH) ) IN A ARRAY.  
  
CON=FLEXK*Q(IQ)*CAPS/CBAR  
DO 168 I=1,NCNRC  
  DO 168 J=1,NRC  
    HN031038  
    HN031039  
    HN031040  
    HN031041  
    HN031042  
    HN031043  
    HN031044  
    HN031045  
    HN031046  
    HN031047  
    HN031048  
    HN031049  
    HN031050  
    HN031051  
    HN031052  
    HN031053  
    HN031054  
    HN031055  
    HN031056  
    HN031057  
    HN031058  
    HN031059  
    HN031060  
    HN031061  
    HN031062  
    HN031063  
    HN031064  
    HN031065  
    HN031066  
    HN031067  
    HN031068  
    HN031069  
    HN031070  
    HN031071  
    HN031072  
    HN031073  
    HN031074  
    HN031075
```

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```
168 A(J,I)=-CON*A(J,I)
      K=0
      DO 169 I=1,NCNRC,NC
      K=K+1
169   A(K,I)=1.+A(K,I)
      IF (NOP(7)) 170,172,170
170   DO 171 I=1,NCNRC,NC
      K=I/2+1
      DO 171 J=1,NRC
      A(J,K)=A(J,I)
171   B(J,K)=A(J,I+1)
172   CALL MNVRSX (A,B,A(1,MAXR+1),C,NRC,MGOOF,NOP(7))
      IF (MGOOF) 174,176,174
174   WRITE OUTPUT TAPE NTAPE3, 22
      Q(1Q)=-1.
      GOTO 202
176   IF (NOP(7)) 177,182,177
177   DO 178 I=1,NCNRC,NC
      K=I/2+1
      DO 178 J=1,NRC
      C(J,I)=A(J,K)
      C(J,I+1)=B(J,K)
178   DO 180 I=1,NCNRC
      DO 180 J=1,NRC
      A(J,I)=C(J,I)
180
182   WRITE TAPE NTAPE8, ((A(I,J),J=1,NCNRC), I=1,NRC)
      C READ FLEXIBILITY MATRIX INTO B ARRAY.
      READ TAPE NTAPE4, ((B(I,J),J=1,NRC), I=1,NRC)
      REWIND NTAPE4
      CALL MMULTD (A,NOP(7),B,O,C,NRC,NRC,MAXR,MAXR,MAXR)
      C READ AERO MATRIX INTO B ARRAY.
```

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```
READ TAPE NTAPES, ((B(I,J), J=1,NCNRC), I=1,NRC)
REWIND NTAPES
CALL MMULTD (B, NOP(7),C, NOP(7),A, NRC, NRC, NRC, MAXR, MAXR)
HMO31114
HMO31115
HMO31116
HMO31117
HMO31118
HMO31119
HMO31120
HMO31121
HMO31122
HMO31123
HMO31124
HMO31125
HMO31126
HMO31127
HMO31128
HMO31129
HMO31130
HMO31131
HMO31132
HMO31133
HMO31134
HMO31135
HMO31136
HMO31137
HMO31138
HMO31139
HMO31140
HMO31141
HMO31142
HMO31143
HMO31144
HMO31145
HMO31146
HMO31147
HMO31148
HMO31149
HMO31150
HMO31151

DO 184 I=1,NCNRC
DO 184 J=1,NRC
184 A(J,I)=CDN*A(J,I)

185 K=0
DO 186 I=1,NCNRC,NC
K=K+1
186 A(K,I)=I.+A(K,I)

188 WRITE TAPE NTAPEB, ((A(I,J), J=1,NCNRC), I=1,NRC)
IF (NOP(15)) 202,202,189
189 WRITE OUTPUT TAPE NTAPE3, 24
IF (NOP(7)) 190,192,190
190 DO 191 I=1,NCNRC,NC
K=I/2+1
DO 191 J=1,NRC
A(J,K)=A(J,I)
191 B(J,K)=A(J,I+1)
192 CALL MNVRSX (A,B,A(I,MAXR+1),C,NRC,MGEOF, NOP(7))
IF (MGEOF) 194,196,194
194 WRITE OUTPUT TAPE NTAPE3, 22
GOTO 202

196 IF (NOP(7)) 197,200,197
197 DO 198 I=1,NCNRC,NC
K=I/2+1
DO 198 J=1,NRC
C(I,J)=A(J,K)
198 C(I,J+1)=B(J,K)
DO 199 I=1,NCNRC
DO 199 J=1,NRC
199 A(J,I)=C(J,I)
200 CALL MMULTD (A,NOP(7),CZRE,NOP(7),B,NRC,NRC,1,MAXR,MAXR)
```

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```
      WRITE OUTPUT TAPE NTAPE3, 23, Q(1Q), ((B(I,J),J=1,NC),I=1,NRC)  HMO31152
      CALL CENTER (B)  HMO31153
      202 READ TAPE NTAPE6, ((A(I,J),J=1,NCNRC),I=1,NRC)  HMO31154
      204 REWIND NTAPE6  HMO31155
      IF (NOP(1)+NOP(2)+NOP(3)+NOP(16)) 207,207,206  HMO31156
      206 CALL LOADS  HMO31157
      207 IF (NOP(5)+NOP(6)+NOP(8)+NOP(9)) 209,209,208  HMO31158
      208 CALL DERIV  HMO31159
      209 IF (NOP(4)) 211,211,210  HMO31160
      210 CALL DIVERG  HMO31161
      211 GOTO 90  HMO31162
      END(1,0,0,0,0,0,0,1,0,0,0,0,0)
```

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STORAGE NOT USED BY PROGRAM

	DEC	UCT	DEC	OCT
	2717	05235	16293	37645

STORAGE LOCATIONS FOR VARIABLES APPEARING IN COMMON STATEMENTS

	DEC	OCT	DEC	OCT	DEC	OCT	DEC	OCT
A	31305	75111	ATTIT	32409	77231	B	26305	63301
CAPHO	32421	77245	CAPH	32428	77254	CAPN	32426	77252
CAPT	32427	77253	CAPXO	32426	77250	CAPZ	32422	77246
CWIN	32209	76721	CON	16296	37650	CBAR	32431	77257
DELY	31858	76162	FLEXK	32430	77256	HADD	32009	76411
IFORM	16295	37647	IRON	16294	37646	I	16305	37661
K	16303	37657	LH	32537	77431	LL	32487	77347
MAXQ	31308	75114	MAXR	32410	77232	MGOOF	16301	37655
MCNR	31306	75112	NCPT	31908	76244	NC	31307	75113
NOP	32561	77461	NQ	32548	77444	NRC	32545	77441
NSTRP	31909	76245	NTAPE2	32437	77265	NTAPE3	32436	77264
NTAPE5	32434	77262	NTAPE6	32433	77261	NTAPE8	32432	77260
Q	32420	77244	SMALS	32425	77251	TITL1	32539	77433
T	16297	37651	X	32537	77431	TITL2	32538	77432
			Y	32487	77347	ZI	31808	76100

SYMBOLS AND LOCATIONS FOR SOURCE PROGRAM FORMAT STATEMENTS

	EFN	LOC	EFN	LOC	EFN	LOC	EFN	LOC
8)1	1	05214	8)2	2	05212	8)3	3	05210
8)5	5	05037	8)6	6	05030	8)7	7	05017
8)9	9	04764	8)A	10	04755	8)B	11	04744
8)D	13	04724	8)E	14	04712	8)F	15	04700
8)H	17	04663	8)I	18	04653	8)J	19	04643
8)L	21	04562	8)M	22	04551	8)N	23	04537

LOCATIONS FOR OTHER SYMBOLS NOT APPEARING IN SOURCE PROGRAM

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	DEC	OCT	DEC	OCT	DEC	OCT	DEC	OCT	DEC	OCT	DEC	OCT
1)	2701	05215	2)	2357	04465	3)	2367	04477	4)	32767	77777	
6)	2371	04503	A)103	2309	04405	A)104	2322	04422	A)106	2335	04437	
A)106	2348	04454	C)1G0	2705	05221	C)1G2	2706	05222	C)1G4	2707	05223	
C)100	2708	05224	C)1I03	2709	05225	C)1I04	2710	05226	C)1I06	2711	05227	
C)108	2712	05230	C)1J00	2713	05231	C)1J0E	2714	05232	C)1J0F	2715	05233	
C)206	2716	05234	D)116	412	00634	D)118	460	00714	D)13T	1211	02273	
D)149	1348	02504	D)14P	1474	02702	D)14V	1512	02750	D)25H	1660	03174	
D)250	1744	0320	D)264	1854	03476	D)271	2110	04076	D)350	1743	03317	
D)364	1853	03475	D)41V	648	01210	D)421	692	01264	D)426	748	01354	
D)455	1792	03400	D)471	2254	04316	D)521	691	01263	D)526	747	01355	
D)655	1791	03377	D)671	2253	04315	E)7	440	00214				

LOCATIONS OF NAMES IN TRANSFER VECTOR

	DEC	OCT	DEC	OCT	DEC	OCT	DEC	OCT	DEC	OCT	
CENTER	16	00020	DERIV	18	00022	DIVERG	12	00014	LOADS	17	00021
MMULTD	11	00013	MNVRSX	15	00017	MPRINT	10	00012	READ	9	00011
RDLN	2	00002	(FIL)	6	00006	(FPT)	0	00000	(RLR)	16	00016
(RTN)	4	00004	(RWT)	1	00001	(STB)	7	00007	(STH)	5	00005
(TSB)	13	00015	(TSH)	3	00003	(WIR)	8	00010	(WRB)	6	00006

ENTRY POINTS TO SUBROUTINES NOT OUTPUT FROM LIBRARY

EXTERNAL FORMULA NUMBERS WITH CORRESPONDING INTERNAL FORMULA NUMBERS AND OCTAL LOCATIONS							
	DERIV (FIL) (TSH)	DIVERG (FPT) (WLR)	LOADS (RLR)	MULTID (RTN)	MVRSX (RTN)	MPRINT (STB)	MREAD (STH)
IFN	LOC	IFN	IFN	LOC	IFN	IFN	LOC
36	00056	98	60	00207	99	61	00215
74	00255	102	75	00260	103	78	00301
88	00343	106	99	00422	107	104	00451
110	00504	111	113	00526	112	119	00566
131	00700	115	132	00715	116	133	00717
136	00724	120	147	00771	121	148	00775

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123	157	01027	124	159	01043	125	160	01050	126	164	01103
127	166	01123	128	170	01160	129	173	01204	130	176	01246
131	179	01265	132	191	01355	119	192	01361	133	1-4	01365
134	195	01371	135	197	01407	136	199	01421	137	212	01547
138	219	01572	139	227	01631	140	228	01633	141	232	01665
142	239	01710	143	247	01747	144	248	01756	145	252	02006
146	259	02031	147	267	02070	148	268	02077	149	272	02127
150	279	02152	151	287	02211	152	288	02220	153	299	02256
154	303	02306	155	317	02422	156	324	02445	157	332	02505
158	333	02517	159	345	02560	160	346	02570	164	380	02724
166	387	02751	168	421	03133	169	425	03211	170	427	03223
171	431	03303	172	432	03321	174	435	03336	176	438	03346
177	439	03350	178	443	03432	180	446	03464	182	447	03477
184	476	03654	185	477	03666	186	480	03726	188	481	03736
189	489	03773	190	491	04003	191	495	04062	192	496	04077
194	499	04114	196	501	04121	197	502	04123	198	506	04201
199	509	04233	200	510	04244	202	522	04317	204	529	04350
206	531	04366	207	532	04367	208	533	04376	209	534	04377
210	535	04403	211	536	04404						

6/22/62
 SUBROUTINE MPRINT (A,M,N,MA,NTAPE)
 C
 C A = MATRIX TO BE PRINTED
 C M = NUMBER OF ROWS MA = DIMENSIONED NUMBER OF ROWS
 C N = NUMBER OF COLUMNS NTAPE = TAPE NUMBER FOR PRINTING
 C
 SUBROUTINE MPRINT (A,M,N,MD,NTAPE)
 C
 DIMENSION A(1), IT(66), CT(6)
 EQUIVALENCE (IT,CJ)
 C
 2 FORMAT (1H0 4X, 6I 6X, 7HCOLUMN 1I4) / 1
 3 FORMAT (1H 1I4, X, 16E 17.6)
 C
 M1=N
 M2=6
 M3=6
 M4=1
 M5=1
 4 IF (M3=M1) 6+5+5
 5 M2=N1-N3+6
 N3=N4
 6 K=0
 D8 7 I=N4+N3
 X=K+1
 13(IK)=I
 7 WRITE(OUTPUTTAPE NTAPE, 2, (IT(I), I=1,N2)
 DO 9 I=1,M
 K=0
 L=M0+(N4-1)*I
 CG 8 J=N4,N3
 K=K+1
 CJ(K)=A(L)
 L=L+MD
 9 WRITE(OUTPUTTAPE NTAPE, 3, 1, (C(IK), K=1,N2)
 IF (M3=M1) 10,11,11
 10 N3=N3+6
 N4=N4+6

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THE RETURN

Emissions from the oil and gas industry

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HNU30039

HMO30039

MPRINT

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STORAGE NOT USED BY PROGRAM

	DEC	OCT		DEC	OCT
189 00275			32561 77461		

STORAGE LOCATIONS FOR VARIABLES APPEARING IN DIMENSION AND EQUIVALENCE STATEMENTS

	DEC	OCT		DEC	OCT
C 188 00274			11 188 00274		

STORAGE LOCATIONS FOR VARIABLES NOT APPEARING IN COMMON, DIMENSION, OR EQUIVALENCE STATEMENTS

	DEC	OCT		DEC	OCT
E 182 00266	K 181 00265		L 180 00264		
N2 178 00262	N3 177 00261		N4 176 00260		

SYMBOLS AND LOCATIONS FOR SOURCE PROGRAM FORMAT STATEMENTS

	EFN	LOC		EFN	LOC
0)2 2 00251	813	3 00241			

LOCATIONS FOR OTHER SYMBOLS NOT APPEARING IN SOURCE PROGRAM

	DEC	OCT		DEC	OCT
1)1 171 00253	2) 149 00225	6) 152 00230		9) 170 00252	
C160 173 00255	C162 174 00256	C)202 175 00257		E)E 137 00211	

LOCATIONS OF NAMES IN TRANSFER VECTOR

	DEC	OCT		DEC	OCT
{FILE} 1 00001	{STH}	0 00000			

ENTRY POINTS TO SUBROUTINES NOT OUTPUT FROM LIBRARY

{FILE} {STH}

NPRIINT

EXTERNAL FORMULA NUMBERS WITH CORRESPONDING INTERNAL FORMULA NUMBERS AND OCTAL LOCATIONS

EEN	IFN	LOC									
4	41	00036	5	12	00043	6	14	00051	7	17	00067
8	29	00151	9	30	00157	10	37	00212	11	40	00221

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SUBROUTINE MMULTD (A,N1,B,N2,C,M,N,K,MA,MB,MC)
DIMENSION A(1), B(1), C(1)

IC=1
IA=MC+K
IB=MA+N
ID=MA
IH=MC
IJ=MC

IF ( N1 ) 4,3,4
3 IF ( N2 ) 7,8,7
4 IB=2*IB
ID=2*ID
IF ( N2 ) 5,6,5
5 IC=2
GOTO 7
6 IH=2*IH
IC=3
7 IA=2*IA
IJ=2*IJ
8 DO 18 I=1,M
INC=0
DO 11 J=1,IA,IH
C(J)=0.
IN=INC
IN=INC
10 C(J)=C(J)+A(I)+B(IN)
11 INC=INC+MB
INC=0
GOTO (18,12,15),IC
12 DO 14 J=1,IA,IJ
IE=I+MA
IF=J+MC
IN=INC
DO 13 L=IF,IB,1D

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```
IN=IN+1  
IG=IN+MB  
C(IF)=C(IF)+A(L)*B(IN)  
C(J)=C(J)-A(L)*B(IG)  
13  INC=INC+MB *2  
14  GOTO 18  
15  IE=I+MC  
IF=I+MA  
DO 17 J=IE,IA,IJ  
1N=INC  
C(J)=0.  
DO 16 L=IF,IB,1D  
1N=IN+1  
C(J)=C(J)+A(L)*B(IN)  
16  INC=INC+MB  
17  INC=INC+MB  
18 CONTINUE  
RETURN  
END(1,0,0,0,0,0,0,1,0,0,0,0,0,0)
```

```
HMO30081  
HMO30082  
HMO30083  
HMO30084  
HMO30085  
HMO30086  
HMO30087  
HMO30088  
HMO30089  
HMO30090  
HMO30091  
HMO30092  
HMO30093  
HMO30094  
HMO30095  
HMO30096  
HMO30097  
HMO30098
```

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STORAGE LOCATIONS FOR VARIABLES NOT APPEARING IN COMMON, DIMENSION, OR EQUIVALENCE STATEMENTS

	DEC	OCT	DEC	OCT
I A	308 00464		18 307 00463	
I E	304 00460		IF 303 00457	
I J	300 00454		INC 299 00453	
J	296 00450		L K	298 00452

STORAGE NOT USED BY PROGRAM

	DEC	OCT	DEC	OCT
C1G0	278 00426	31 282 00432	61 283 00433	
C1G2	290 00442	C1G2 291 00443	C1G3 292 00444	
C1G5	294 00446	C1200 295 00447	01200 174 00256	
D140M	268 00414	E11 81 00121		D1407 123 00173

LOCATIONS FOR OTHER SYMBOLS NOT APPEARING IN SOURCE PROGRAM

	DEC	OCT	DEC	OCT
3	11 00122	4 12 00126	5 15 00140	
7	19 00155	8 21 00165	10 28 00223	
12	32 00246	13 40 00317	14 41 00327	
16	50 00377	17 51 00405	18 52 00415	

EXTERNAL FORMULA NUMBERS WITH CORRESPONDING INTERNAL FORMULA NUMBERS AND OCTAL LOCATIONS

MREAD

7/26/62

```
C MATRIX READ SUBROUTINE          MM030101
C CALL MREAD   IA,N,IROW,IFORM,IORG,ITRA,MD,NTAPE2,NTAPE3    7 MM030102
C
C   A = MATRIX TO READ IN      ITRA = 0, TRA CARD AFTER MATRIX MM030103
C   N = NUMBER OF ROWS        ++1, TRA CARD AFTER EACH ROW MM030104
C   N = NUMBER OF COLUMNS     (OR COLUMN 1 MM030105
C   IFORM = -1, FORMAT(12A6)   IORG = ORIGIN OF FIRST C.B. CARD MM030106
C   = 0, COLUMN BINARY       T = MDXN TEMPORARY CELLS MM030107
C   = +1, FORMAT(12.8)        MD= DIMENSIONED NUMBER OF ROWS MM030108
C   IROW = -0, MATRIX BY COLUMNS IN A MM030109
C   = +1, MATRIX BY ROWS    NTAPE2 = INPUT TAPE MM030110
C   NTAPE3 = OUTPUT TAPE    MM030111
C
C SUBROUTINE MREAD  (A,M,N,IFORM,IROW,IORG,ITRA,MD,NTAPE2,NTAPE3)MM030112
C DIMENSION A(1), T(1) MM030113
C
C   1 FORMAT (6E12.8)           MM030114
C   2 FORMAT (12A6)             MM030115
C   3 FORMAT (1F26H) THATS ALL YOUR DATA. MM030116
C   NN=MD*N                  MM030117
C   DO 5 I=1,NN                MM030118
C   T(I)=0.                   MM030119
C   5 A(I)=0.                 MM030120
C
C   IF (IFORM) 39,15,6          MM030121
C   6 IF (IROW) 8,7,8           MM030122
C   7 K3=1                      MM030123
C   K4=N                      MM030124
C   K5=MD                      MM030125
C   K6=N-1                     MM030126
C   K2=1                       MM030127
C   GO TO 9                     MM030128
C
C   8 K2=NN                     MM030129
C   K3=MD                     MM030130
C   K4=N                       MM030131
C   K6=1                       MM030132
C   GO TO 9                     MM030133
C
C   9 K3=MD                     MM030134
C   K4=N                       MM030135
C   K6=1                       MM030136
C   GO TO 137                  MM030137
```

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PREAD

```
9 DO 11 I=1,K4  
   K1=I+K5-K5+1  
   IF (K6) 10,11,10  
10 K2=K1+K6  
11 READ INPUT TAPE NTAPE52, 1, (A(L),L=K1,K2,K3)  
   GOTO 36  
15 K1=N  
   K2=M  
   K3=1  
   IF ( LORG-1 ) 16,17,17  
16 K3=2  
17 IF ( IRON ) 18,19,18  
18 K2=N  
   K1=M  
19 IF ( ITRA ) 22,21,22  
21 K1=1  
22 K=0  
DO 23 I=1,K1  
   K4=K+K3  
   K5=1  
   CALL BINRD (T(K4), K5, L, NTAPE2, NTAPE3 )  
   GOTO 123,38,23),L  
23 K=K+K2  
   IF ( IRON ) 28,24,28  
24 L=0  
   IF ( LORG-1 ) 26,26,25  
25 L=LORG-1  
26 GO 27 I=1,N  
   J=1+MD-MD  
   DO 27 K=1,M  
      J=J+1  
      L=L+1  
27 A(J)=T(L)  
   GOTO 36  
28 L=0  
   IF ( LORG-1 ) 30,30,29  
   HH030138  
   HH030139  
   HH030140  
   HH030141  
   HH030142  
   HH030143  
   HH030144  
   HH030145  
   HH030146  
   HH030147  
   HH030148  
   HH030149  
   HH030150  
   HH030151  
   HH030152  
   HH030153  
   HH030154  
   HH030155  
   HH030156  
   HH030157  
   HH030158  
   HH030159  
   HH030160  
   HH030161  
   HH030162  
   HH030163  
   HH030164  
   HH030165  
   HH030166  
   HH030167  
   HH030168  
   HH030169  
   HH030170  
   HH030171  
   HH030172  
   HH030173  
   HH030174  
   HH030175
```

PREVIEW

READ

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STORAGE NOT USED BY PROGRAM

DEC	OCT
403	00623
	32561 77461

STORAGE LOCATIONS FOR VARIABLES NOT APPEARING IN COMMON, DIMENSION, OR EQUIVALENCE STATEMENTS

DEC	OCT
I	402 00622
K3	398 00616
K	394 00612
J	401 00621
K4	397 00615
L	393 00611
K1	400 00620
K5	396 00614
MN	392 00610

SYMBOLS AND LOCATIONS FOR SOURCE PROGRAM FORMAT STATEMENTS

EFFN	LOC
0)1	1 00576
8)2	2 00574
8)3	3 00572

LOCATIONS FOR OTHER SYMBOLS NOT APPEARING IN SOURCE PROGRAM

DEC	OCT
2)	361 00551
C1G1	385 00601
C)200	389 00605
D)212	299 00453
E)J	189 00275
3)	364 00554
C)G2	386 00602
C)203	390 00606
D)216	335 00517
E)N	224 00340
6)	365 00555
C)G3	387 00603
C)205	391 00607
E)E	168 00250
9)	383 00577
C)G4	388 00604
D)107	126 00176
E)H	179 00263

LOCATIONS OF NAMES IN TRANSFER VECTOR

INRD	OCT
2	00002
3	00003

EXIT (TSW)	OCT 5 00005 0 00000
	(FIL)

RTN	OCT 4 00004 1 00001
	(RTN)

ENTRY POINTS TO SUBROUTINES NOT OUTPUT FROM LIBRARY

INRD	EXIT
	(FIL)
	(RTN)
	(STW)
	(TSW)

MREAD

7/26/62

EXTERNAL FORMULA NUMBERS WITH CORRESPONDING INTERNAL FORMULA NUMBERS AND OCTAL LOCATIONS

EFN	IFN	LOC									
5	10	00122	6	12	00132	7	13	00136	8	19	00154
9	24	00170	10	27	00211	11	28	00214	15	34	00235
16	38	00251	17	39	00253	18	40	00255	19	42	00264
21	43	00270	22	44	00276	23	51	00333	24	53	00345
25	55	00356	26	56	00363	27	61	00415	28	63	00427
29	65	00440	30	66	00445	31	71	00504	36	72	00520
38	74	00524	39	77	00535						

BINRD ROUTINE TO READ CQL BIN CARDS FROM INPUT TAPE. FIBII

6/22/62

```

*   FIB II    FEBRUARY 10, 1961   ROGER ANDERSON
*   FIB II    APRIL 20, 1961 REVISED AND CORRECTED BY R. L. GAUTHIER
*-----*-----*-----*-----*-----*-----*-----*-----*-----*-----*-----*
* CALLING SEQUENCE
*   TSX      BINRD,4
*   TSX      L(LARRAY)
*   TSX      L(K1), WHERE K1 IS READ CONTROL.
*   TSX      L(K2), WHERE K2 IS ERROR CONTROL.
*   TSX      L(LINPUT TAPE NUMBER)
*   TSX      L(LOUTPUT TAPE NUMBER)
*-----*-----*-----*-----*-----*-----*-----*-----*-----*-----*-----*
*   K1 = ZERO, READ ONE CARD.
*   K1 = NONZERO, READ TO TRANSFER CARD.
*-----*-----*-----*-----*-----*-----*-----*-----*-----*-----*-----*
* IF      K2 = 1, RECORD(S) READ CORRECTLY.
*         K2 = 2, END OF FILE ENCOUNTERED. READ END.
*         K2 = 3, CHECKSUM ERROR OR TAPE CHECK.
*         K2 = 4, (WHEN K1=0) NEXT RECORD IS BCD.
*-----*-----*-----*-----*-----*-----*-----*-----*-----*-----*-----*
*-----*-----*-----*-----*-----*-----*-----*-----*-----*-----*-----*
*   ENTRY    BINRD
*-----*-----*-----*-----*-----*-----*-----*-----*-----*-----*-----*
*-----*-----*-----*-----*-----*-----*-----*-----*-----*-----*-----*
* TRANSFER VECTOR
*-----*-----*-----*-----*-----*-----*-----*-----*-----*-----*-----*
* 00000  743146523460  (IOS)
* 00001  745124623460  (ROS)
* 00002  746123303460  (RCH)
* C0003  746323463460  (TC0)
* C0C94  746351233460  (TRC)
* 00005  746325263460  (TEF)
* 00006  742262513460  (BSR)
* 00007  256731636060  EXIT
* 00010  746651623460  (WRS)
*-----*-----*-----*-----*-----*-----*-----*-----*-----*-----*-----*
* 00011  Q634  00 4 00156  BINRD  SXA  BRDXR4,4  SAVE INDEX REGISTERS.
* 00012  0634  00 2 00157  SXA  BRDXR2,2
* 00013  C634  00 1 00160  SXA  BRDXR1,1
* 00014  0500  60 4 00004  CLA*  4,4
*-----*-----*-----*-----*-----*-----*-----*-----*-----*-----*-----*

```


BINRC ROUTINE TO READ COL BIN CARDS FROM INPUT TAPE. F1B1I

6/22/62

```

00044 -0560 00 0 77740 BRDTCT CAL BUFFER IF DECREMENT (WORD COUNT)
00045 -0320 00 0 00250 ANA BRDD37 IS ZERO, THIS IS
00046 0160 00 0 00152 TZE BRDTCD A TRANSFER CARD. .....
***** TEST TO IGNORE CHECKSUM.
00047 -0560 00 0 77740 CAL BUFFER IF COL 1, ROW 0
00050 -0320 00 0 00254 ANA BRDIGN IS PUNCHED, IGNORE
00051 -0100 00 0 00071 TNZ BRDMV THE CHECKSUM.

***** ACCUMULATE AND CHECK THE CHECKSUM. *****
* IF CHECKSUM ERROR, WRITE MESSAGE, INDICATE
* ERROR WITH 3 AT K2, AND CONTINUE.
* (THE CARD WILL BE MOVED INTO THE ARRAY.)
***** SET UP NO. OF WORDS FOR COMPUTING CHECKSUM
*          BINWDS+4
*          TXI *+1,4+2
*          SXD **+2+4
*          AXT BUFFER+4
*          TXI *+1,4+2
*          SXA BINCK+4
*          AXT **+4
BINWDS 00052 -0560 00 0 77740 CAL BUFFER
00053 -0320 00 0 00250 ANA BRDD37
00054 -0734 00 4 00000 PDX 0+4
00055 0634 CO 4 00063 SXA BINWDS+4
C0056 1 C0002 4 00057 TXI *+1,4+2
00057 -0634 00 4 00061 SXD **+2+4
00060 0774 00 4 77740 AXT BUFFER+4
00C61 1 800000 4 00062 TXI *+1,4+2
C0062 0634 00 4 00065 SXA BINCK+4
C0063 0774 00 4 00000 BINWDS AXT **+4
C0064 -0560 00 0 77740 CAL BUFFER
00065 0361 00 4 00000 BINCK ACL **+4
00C66 2 C0001 4 00065 TXI *-1+4+1
00067 0322 00 0 77741 ERA BUFFER+1
00070 -0100 00 0 00144 TNZ BRDCSE

***** MOVE THE CARD IMAGE INTO USERS ARRAY. *****
* THE ARRAY IS FILLED IN FORTRAN FASHION. (BACKWARDS)
* THE INDEX NUMBER LOCATES THE FIRST WORD IN ARRAY.
* THE WORD COUNT IS USED TO TERMINATE THE MOVE.
* BY DEFN... IF THE INDEX NUMBER = 1, PLACE FIRST WORD AT L(ARRAY). . . MM030295
***** CHECKSUM ERROR
*          MM030288
*          MM030289
*          MM030290
*          MM030291
*          MM030292
*          MM030293
*          MM030294
*          MM030295
***** MM030296

```

SIMRE ROUTINE TO READ COL 8IN CARDS FROM INPUT TAPE. FIBII

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BINRC ROUTINE TO READ COL BIN CARDS FROM INPUT TAPE. FIG11

6/22/62

00124 -0500 00 0 00247	CAL	BRD3D	RECORD IS BCD MODE.
00125 0534 C0 4 00156	LXA	BRDXR4,*4	HMO30336
00126 0460 00 0 00245	ADD	BRDID	HMO30337
00127 0492 60 4 00003	SLW*	3,*4	HMO30338
00130 0020 00 0 00157	TRA	BRDXR2	HMO30339
	*		EXIT FROM BINRD.
00131 -0500 00 0 00243	BRDBTC	CAL	IF REDUNDANCY IS
00132 0771 00 0 00001	ARS	ONE	CONSISTENT, REPORT
00133 0602 00 0 00243	SLW	1	AND EXIT.
00134 0520 00 0 00243	ZET	ONE	HMO30343
00135 0620 00 0 00031	TRA	BR, RDI	HMO30344
00136 0534 C0 4 00156	LXA	BRDXR4,*4	HMO30345
00137 -0500 00 0 00247	CAL	BRD3D	HMO30346
00140 0602 60 4 00003	SLW*	3,*4	HMO30347
00141 0774 00 1 00001	AXT	1,*1	HMO30348
00142 0034 00 4 00173	TSX	BRDRPT,*4	HMO30349
00143 0020 00 0 00042	TRA	BRDTEF	HMO30350
	*		HMO30351
00144 0774 C0 1 00000	BRDCSE	AXT	HMO30352
00145 0534 00 4 00156	LXA	BRDXR4,*4	HMO30353
00146 -0500 00 0 00247	CAL	BRD3D	HMO30354
00147 0602 60 4 00003	SLW*	3,*4	HMO30355
00150 0674 00 4 00173	TSX	BRDRPT,*4	HMO30356
00151 0020 00 0 00071	TRA	BRDMV	HMO30357
	*		HMO30358
00152 0534 00 4 00156	BRDTCDF	LXA	HMO30359
00153 -0560 00 0 77740	CAL	BUFFER	HMO30360
00154 0767 00 0 00022	ALS	1,*8	HMO30361
00155 0622 60 4 00002	STD*	2,*4	HMO30362
00156 0774 00 4 00000	BRDXR4	AXT	HMO30363
00157 0774 C0 2 00000	BRDXR2	AXT	HMO30364
00160 0774 00 1 00000	BRDXR1	AXT	HMO30365
00161 0020 00 4 00006	TRA	6,*4	HMO30366
	*		HMO30367
00162 0502 00 0 00246	BRDEND	CLS	HMO30368
00163 0522 60 0 00006	XEC*	\$ (BSR)	HMO30369
00164 0020 00 0 00165	TRA	*+1	HMO30370
00165 0760 00 0 00002	CHS		HMO30371
			HMO30372
			THIS WILL RETURN
			CONTROL TO USER
			AT FIRST EOF, BUT
			WILL TAKE SYSTEM

SIMRS ROUTINE TO READ COL BIN CARDS FROM INPUT TAPE. FIBII

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BINRC ROUNTINE TO READ COL BIN CARDS FROM INPUT TAPE. FIBRI

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002221	C634	C0 4	00240	RPTERR	SXA	BRDCOM,4	REMEMBER LAST COMMAND.
002222	-0774	00 4	00223	AJC	*+1,4	DELAY AND TEST	
002223	0522	60 0	00003	XEC*	\$ITCO)	REDUNDANCY ON OUTPUT.	
002224	-0774	C0 4	00231	AJC	IPTPCH,4		
002225	0522	60 0	00004	XEC*	\$ITRC)		
002226	-0500	00 0	00252	CAL	BRDBSD	REESTABLISH IO FOR	
002227	0074	00 4	00000	CALL	(I0S)	INPUT TAPE....	
002230	0020	00 2	00001	TRA	1,2		
002231	0522	60 0	00006	IPTPCH	XEC*	BACKSPACE OUTPUT	
002232	0522	60 0	00010	XEC*	\$I(WRS)	TAPE AND ERASE.	
002233	-0774	C0 4	00234	AJC	*+1,4		
002234	0522	60 0	00003	XEC*	\$ITCO)		
002235	-0774	C0 4	00237	AJC	*+2,4	TURN OFF POSSIBLE	
002236	0522	60 0	00004	XEC*	\$ITRC)	REDUNDANCY.	
002237	0522	60 0	00010	XEC*	\$I(WRS)		
C02240	0774	C0 4	00000	BRDCOM	AXT		
002241	0522	60 0	00002	XEC*	*+1,4	RETRY WRITE.	
002242	0020	00 0	00221	TRA	\$IRCH)		
				RPTERR			
			*				
002243	0	000C1	0	00000	ONE	PZE	0,0,1
002244	0	000C0	0	00001	BRCLIA	PZE	1
002245	0	00001	0	00000	BRD1D	PZE	0,0,1
002246	0	00002	0	00000	BRD2C	PZE	0,0,2
C0247	0	00003	0	00000	BRD3D	PZE	0,0,3
002250	0	00037	0	00000	BRCD37	PZE	0,0,31
002251	0	00003	0	00000	BRD6D	PZE	0,0,3
002252	0	00002	0	00020	BRDBSD	PZE	16,0,2
002253	+0000000777777			BRD5A7	OCT	77777	
002254	1	CC0C0	0	00000	BRCLGN	PQN	0,0,0
002255	0	00000	0	77740	BUFORG	PZE	BUFFER
002256	0	00000	0	00000	BRDCSV	PZE	
			*				
002257	-3	00033	0	77740	BRDCMD	IOST	BUFFER,0,27
002260	0	00005	0	00262	REC,MC	10CD	BRDMG1,0,5
002261	0	00006	0	00267	CSECMD	10CD	BRDMG2,0,6
			*				
			*				MESSAGES

BINAC ROUTINE TO READ COL BIN CARDS FROM INPUT TAPE. F1B11

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00262	016321472560	BRDNG1 BCI	5,1 TAPE CHECK ON INPUT IGNORED.	
00263	233025234260			HMO30449
00264	464560314547			HMO30450
00265	AA636C312745			
00266	465125243360	BRDNG2 BCI	3,1 CHECKSUM ERROR	HMO30451
00267	012330252342			
00270	626444602551			
00271	514651606060	BRDCHK BCI	3,	HMO30452
00272	606060606060			
00273	606060606060			HMO30453
00274	606060606060	77740 BUFFER EQU	-32	HMO30454
		END		

BINRD ROUTINE TO READ COL BIN CARDS FROM INPUT TAPE. FIBII
POST PROCESSOR ASSEMBLY DATA

275 IS THE FIRST LOCATION NOT USED BY THIS PROGRAM

REFERENCES TO DEFINED SYMBOLS
243 CNE 23*, 41, 131, 133, 134
7 EXIT 167
65 BINCK 62
11 BINRD
244 BRC1A 25
245 BRC1D 20*, 22*, 40*, 126
246 BRC2D 162
247 BRC3D 124*, 137*, 146
251 BRC6D 17*, 174
71 BREMV 51, 151
27 BRCRD
6 {ESR} 110*, 163*, 231
0 {ICSI} 30*, 175*, 227
2 {RCH} 33*, 113*, 201, 216, 241
1 {RCS} 31
3 {TCO} 35*, 223*, 234
5 {TEF} 43
4 {TRC} 37*, 225*, 236
10 {WRS} 176*, 232*, 237
63 BINDS 55
253 BRC5AT 120
100 BRCARY 26
252 BRC85D 15*
131 BRCBTC 123
272 BRCCHK 213
257 BRCMD 32
240 BRCOM 221
144 BRCSE 70
256 BRECSV 111*, 45*, 53*, 73
250 BRC37
162 BRCEND 42
254 BRCIGN 50
262 BRCNG1 260
267 BREMG2 261

BINRC ROUTINE TO READ COL BIN CARDS FROM INPUT TAPE. FIBII
POST PROCESSOR ASSEMBLY DATA

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103	BRCHW1	75
31	BRCRDA	106,
173	BRCRPT	142,
152	BRCTCD	150
44	BRCTCT	46
42	BRCTEF	143
110	BRCTPC	36
160	BRCRM1	13
157	BRCRM2	12,
156	BRCRM4	11,
77740	BUFFER	104,
77740	BUFCRG	44,
255	BUFCRG	47,
261	CSECMO	121
231	IPTPCH	215
260	RECCMO	224
285	RPTCSE	200
207	RPTECH	177
210	RPIEDT	214
221	RPTERR	212
203	RPTRR4	202,
		217,
		220
		173,

NO ERROR IN ABOVE ASSEMBLY.

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```
SUBROUTINE RDLN (NTAPE2, NTAPE3, I )
1 FORMAT(10H
1
2 FORMAT(1I1)
3 FORMAT(4 1HO )
4 READ INPUT TAPE NTAPE2, 1
 6010  (4,5),1
5 WRITE OUTPUT TAPE NTAPE3, 2
 6016  6
6 RETURN
END(110,0,0,0,0,0,0,0,0,0,0,0,0,0,0)
```

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STORAGE NOT USED BY PROGRAM

DEC OCT
76 00114 DEC OCT
32561 77461

SYMBOLS AND LOCATIONS FOR SOURCE PROGRAM FORMAT STATEMENTS

EFN LOC
1 00112 EFN LOC
812 2 00073 EFN LOC
813 3 00072

LOCATIONS FOR OTHER SYMBOLS NOT APPEARING IN SOURCE PROGRAM

DEC OCT
52 00064 C)GO DEC OCT
75 00113 E)1 DEC OCT
28 00034

LOCATIONS OF NAMES IN TRANSFER VECTOR

DEC OCT
(RTN) 1 00001 (STH) DEC OCT
1 00002 (TSH) 2 00002 (TSH) DEC OCT
0 00000

ENTRY POINTS TO SUBROUTINES NOT OUTPUT FROM LIBRARY

(FIL) (RTN) (STH) (TSH)

EXTERNAL FORMULA NUMBERS WITH CORRESPONDING INTERNAL FORMULA NUMBERS AND OCTAL LOCATIONS

EFN LOC
4 8 C0035 EFN IFN LOC
5 10 00044 EFN IFN LOC
6 11 00052 EFN IFN LOC

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SUBROUTINE	MMRREX (AR,AI,B,C,KSZ,IGOOD,NOB)	
DIMENSION	AR(50,50), AI(50,50), B(50,50), C(50,50)	
16000FD=0		HMO30473
IF 1 NOB = 1	102,101,102	HMO30474
101 CALL INVERS 1AR,KSZ,IGOOD)	102,101,KSZ,IGOOD)	HMO30475
60 TO 20		HMO30476
102 CONTINUE		HMO30477
DO 1 K=1,KSZ		HMO30478
DO 2 I=1,KSZ		HMO30480
BIK,UJ=ARIK,LJ		HMO30481
NG=0		HMO30482
CALL INVERS(B,KSZ,NO)		HMO30483
IF (NOB) 2,3,2		HMO30484
C REAL MATRIX NOT SINGULAR		HMO30485
C MULT B*AI STO1 C		HMO30486
3 DO 4 K=1,KSZ		HMO30487
DO 4 A=1,KSZ		HMO30488
C4K,UI=0,0		HMO30489
DO 4 I=1,KSZ		HMO30490
4 C4K,LJ=C4K,LJ*B4K,LJ*AI(L,L)		HMO30491
C MULT A1EC * AR STO B		HMO30492
DO 5 K=1,KSZ		HMO30493
DO 5 L=1,KSZ		HMO30494
BIK,LJ=ARIK,LJ		HMO30495
DO 6 I=1,KSZ		HMO30496
BIK,UJ=B4K,LJ*AI(L,L)		HMO30497
NG=0		HMO30498
CALL INVERS(B,KSZ,NO)		HMO30500
IF (NOB) 2,7,2		HMO30501
C SECOND MATRIX NOT SINGULAR		HMO30502
C M4N, -C4B STO AI ALSO SET AR=0		HMO30503
7 DO 8 K=1,KSZ		HMO30504
DO 8 I=1,KSZ		HMO30505
A1IK,UI=0,0		HMO30506
ARIK,UJ=B4K,LJ		HMO30507
DO 8 I=1,KSZ		HMO30508
		HMO30509
		HMO30510

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```
8   A(I,K,L)=A(I,K,L)-C(I,K,I)*B(I,L)
      GO TO 20
;  REAL MATRIX OR SECOND MATRIX SINGULAR      TRY IMAG. ROUTE
2   DO 9 K=1,KSZ
     DO 9 L=1,KSZ
9   B(I,K,L)=A(I,K,L)
     NO=0
     CALL INVERS(B,KSZ,NO)
     IF (NO) 10,11,10
C   IMAG. NOT SINGULAR
C   MULT. B*AR    STC. C
11   DO 12 K=1,KSZ
     DO 12 L=1,KSZ
     C(I,K,L)=0.0
     DO 12 I=1,KSZ
12   C(I,K,L)=C(I,K,L)+B(I,K,I)*AR(I,L)
C   MULT. AR*C+AI   STO B
     DO 13 K=1,KSZ
     DO 13 L=1,KSZ
     B(I,K,L)=A(I,K,L)
     DO 13 I=1,KSZ
13   B(I,K,L)=B(I,K,L)+AR(I,K,I)*C(I,L)
     NO=0
     CALL INVERS(B,KSZ,NO)
     IF (NO) 10,15,10
C   THIRD MATRIX NOT SINGULAR
C   MULT -C*B   STO AR ALSO SET AI=-B
15   DO 16 K=1,KSZ
     DO 16 L=1,KSZ
     AR(I,K,L)=0
     A(I,K,L)=-B(I,K,L)
     DO 16 I=1,KSZ
16   AR(I,K,L)=AR(I,K,L)+C(I,K,I)*B(I,L)
     GO TO 20
1C   1 GEOF D=1
20   RETURN
END(1,C,0,0,0,0,0,0,1,0,0,0,0)
```

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STORAGE NOT USED BY PROGRAM

	DEC	OCT
\$13	01001	32561 77461

STORAGE LOCATIONS FOR VARIABLES NOT APPEARING IN COMMON, DIMENSION, OR EQUIVALENCE STATEMENTS

	DEC	OCT
NC	512	01000

LOCATIONS FOR OTHER SYMBOLS NOT APPEARING IN SOURCE PROGRAM

	DEC	OCT
C)10C	499	00763
D)411	510	00776
	362	00552

	DEC	OCT
C)101	502	00766
D)41E	511	00777
	463	00717

LOCATIONS OF NAMES IN TRANSFER VECTOR

	DEC	OCT
INVERS	0	00000

ENTRY POINTS TO SUBROUTINES NOT OUTPUT FROM LIBRARY

INVERS

EXTERNAL FORMULA NUMBERS WITH CORRESPONDING INTERNAL FORMULA NUMBERS AND OCTAL LOCATIONS

EFN	IFN	LOC	EFN	IFN	LOC	EFN	IFN	LOC
101	6	00202	102	9	00207	1	12	00222
4	21	00274	5	26	00352	7	31	00406
2	38	00470	9	40	00503	11	45	00524
13	54	00635	15	59	00671	16	64	00732
20	67	00757					10	66 00755

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```
SUBROUTINE INVERS (A,N,I GOOF D)
CIPENSION A(50,50),L(50),M(50)
IF ACCUMULATOR OVERFLOW 500,500
500 IF QUOTIENT OVERFLOW 501,501
501 IF DIVIDE CHECK 502,502
502 IFCCFD=0
      IGCFCF=0
C SEARCH FOR LARGEST ELEMENT
DO 80 K=1,N
  L(K)=K
  P(K)=K
  BIGA=A(I,K,K)
  CO 20 I=K,N
  DO 20 J=K,N
    IF(ABS(F(BIGA))-ABSF(A(I,J)))1C,20,20
10   BIGA=A(I,J)
  L(K)=I
  P(K)=J
  CCONTINUE
20   CCONTINUE
C INTERCHANGE ROWS
  JRCH=L(K)
  IF(L4K)-K)35,35,25
25   CO 30 I=1,N
  HOLD=A(K,I)
  A(I,K)=A(JRCH,I)
  A(JRCH,I)=HOLD
  C INTERCHANGE COLUMNS
  ICCL=M(K)
  IF IM4KJ-K)45,46,37
37   CO 40 J=1,N
  HOLD=A(I,J)
  A(I,J)=A(J,K)
  A(J,K)=HOLD
  CCL=M(K)
  C DIVIDE COLUMN BY MINUS PIVOT
35   CO 55 IC=1,N
46   IF IM(C-K)50,55,60
50   A(I,C,K)=A(I,C,K)/(-A(K,K))
55   CCONTINUE
C REDUCE MATRIX
```

6/22/62
 HN030586
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 HN030622
 HN030623

```

DO 65 I=1,N
  DO 65 J=1,N
    56   4FM4-K157,65,67
    57   4FM4-K160,65,60
    60   AIJ,JI=AII,KIJ=A(K,J)+A(I,J)
    65   CONTINUE
C     DIVIDE ROW BY PIVOT
  DO 75 JR=1,N
    68   4FM4-N)70,75,70
    70   AIK,JK=A(K,JK)/AIK+K)
    75   CONTINUE
C     CONTINUED PRODUCT OF PIVOTS
C     REPLACE PIVOT BY RECIPROCAL
    AIK,AII=1.0/AIK,K)
C     CONTINUE COMPLETE OPERATION
    80   CONTINUE
C     DIVIDE CHECKS10,503
  503  IF ACCUMULATOR OVERFLOW S10,504
  504  IF QUOTIENT OVERFLOW S10,505
C     FINAL ROW AND COLUMN INTERCHANGE
    505  X=N
    100  K=N-1
        4FM40150,150,103
    103  1-L(IK)
        4F(((-K))120,120,106
    105  DO 310 J=1,N
        HOLB=A(IJ,K)
        AIJ,MJ=A(IJ,IJ)
        AIW,I3=MOLD
    110  J=R(K)
        4F(IJ-K)100,100,125
    125  DO 130 I=1,N
        HOLB=A(IK,IJ)
        AIK,I1=A(IJ,IJ)
    130  AIU,MJ=MOLD
        GO TO 100
    150  RETURN
  610  4 GEOF D=1

```

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HPO30624

GO TO 150
END(1,0,0,0,0,0,0,0,1,0,0,0,0,0)

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STORAGE NOT USED BY PROGRAM

	DEC	OCT	DEC	OCT
601	01131		32561	77461

STORAGE LOCATIONS FOR VARIABLES APPEARING IN DIMENSION AND EQUIVALENCE STATEMENTS

	DEC	OCT	DEC	OCT
A	600	01130	M	550 01046

STORAGE LOCATIONS FOR VARIABLES NOT APPEARING IN COMMON, DIMENSION, OR EQUIVALENCE STATEMENTS

	DEC	OCT	DEC	OCT	DEC	OCT	DEC	OCT
BIGA	500	00764	MOLD	499 00763	ICOL	498 00762	IC	497 00761
C	496	00760	JROW	495 00757	JR	494 00756	J	493 00755
E	492	00754						

LOCATIONS FOR OTHER SYMBOLS NOT APPEARING IN SOURCE PROGRAM

	DEC	OCT	DEC	OCT	DEC	OCT	DEC	OCT
I	472	00730	2)	462 00716	3)	465 00721	4)	32767 77777
G	466	00722	9)	471 00727	C1G0	476 00734	C1H0	477 00735
C1I01	478	00736	C1I02	479 00737	C1I04	480 00740	C1I06	481 00741
C1I07	482	00742	C1I08	483 00743	C1I09	484 00744	C1I0A	485 00745
C1R00	486	00746	C1202	487 00747	C1203	488 00750	C1205	489 00751
C1R06	490	00752	C1207	491 00753	D1I0C	192 00300	D1I0E	205 00315
D1I0J	244	00364	D1I0P	280 00430	D1I0R	290 00442	D1I19	413 00635
D1I18	424	00650	D1I1D	442 00672	D1I1F	454 00706	D120N	271 00417
D120U	320	00500	D130J	243 00363	D130U	319 00477	D1319	412 00634
D131D	441	00671	D1406	222 00336	D1401	235 00353	D170J	242 00362
D1719	411	00633	D171D	440 00670	E1A	183 00267	E1T	309 00465
E147	379	00573						

EXTERNAL FORMULA NUMBERS WITH CORRESPONDING INTERNAL FORMULA NUMBERS AND OCTAL LOCATIONS

6/22/62

EFFN	IFN	LOC									
500	6	00104	501	8	00107	502	9	00111	10	17	00246
20	20	00254	25	23	00277	30	26	00305	35	27	00316
37	29	00325	40	32	00343	45	33	00354	46	34	00365
50	35	00370	55	36	00375	56	39	00425	57	40	00431
60	41	00434	65	42	00443	68	44	00501	70	45	00504
75	46	00507	80	48	00517	503	50	00552	504	52	00555
505	54	00560	100	55	00563	103	57	00574	105	59	00603
110	62	00642	120	63	00651	125	65	00660	130	68	00677
15C	70	00707	510	72	00713						

SWEET SURREIN

```

C COMPUTES TRUE MODE AND SWEEPS IT FROM THE MATRIX. (REAL OR COMPLEX)
C
C HTRUE = TRUE MODAL COLUMNS, AS COMPUTED. U = DYNAMIC MATRIX.
C H = SERIES OF MODIFIED MODAL COLUMNS. FL= COLUMN OF EIGENVALUES.
C US = SERIES OF MODIFIED MODAL ROWS OF U.
C MODE = MODE NOW BEING COMPUTED.
C MD = DIMENSIONED NUMBER OF ROWS OF U.US,H,HTRUE
C NX = 1 IF PROBLEM IS REAL.
C = 2 IF PROBLEM IS COMPLEX.

SUBROUTINE SWEEPX (HTRUE, U,H, US,FL, MODE, N, MD, NC, INDEX, EP)

DIMENSION H(1), US(1), U(1), HTRUE(1), FL(1), G(4)

H=MODE-1
K1=H+NC+MD
DO   6   J=1,NC
    K=K1+(J-1)*MD
    DO   6   L=1,N
        K=K+1
        6   HTRUE(K)=H(K)
        IF ( M ) 31,31,8
        DO 25  I=1,M
            L1=NC*MD*(MODE-1) - NC*MD
            GOTO  ( 9,11 ),NC
        9  G=0.
        DO 10  J=1,N
            L=L1+J
            K=K1+J
            G=G+US(L)*HTRUE(K)
        10  GOTO 13
        11  G(1)=0.
              G(2)=0.
        DO 12  J=1,N
            L=L1+J1
            K=K1+J1
            L2=L+MD
            K2=K+MD
        12  HMO30636
    HMO30637
HMO30638
HMO30639
HMO30640
HMO30641
HMO30642
HMO30643
HMO30644
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HMO30649
HMO30650
HMO30651
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HMO30658
HMO30659
HMO30660
HMO30661
HMO30662
HMO30663
HMO30664

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S W E E P X S U B R O U T I N E

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G(1)=G(1)+US(L)*HTRUE(K1)-US(L2)*HTRUE(K2)
12 G(2)=G(2)+US(L)*HTRUE(K2)+US(L2)*HTRUE(K)
13 K=MODE-1
      GOTO (14,19)*NC
14 IF (ABS(FL(K)/FL(MODE)-1.) < EP )      15,15,16
15 G=1.
      GOTO 17
16 G=(FL(K)-FL(MODE))/ G
17 DO 18 J=1,N
      K=K1+J
      L=L1+J
      HTRUE(K)=H(L)-G(1)*HTRUE(K)
      GOTO 25
18
19 K=2*K
      J=2*MODE
      IF ( ABSF((FL(K-1)*FL(J-1)+FL(K)*FL(J))/(FL(J-1)**2+FL(J)**2)-1.) )
1     -EP)          20,20,22
20 IF ( ABSF((FL(K)*FL(J-1)-FL(K-1)*FL(J)) / (FL(J-1)**2+FL(J)**2) )
1     -EP)          21,21,22
21 G(1)=1.
      G(2)=0.
      GOTO 23
22 G(3)=G(1)**2+G(2)**2
      G(4)=(FL(K)-FL(J))*G(1)-(FL(K-1)-FL(J-1))*G(2)
      G(1)=(FL(K-1)-FL(J-1))*G(1)+(FL(K)-FL(J))*G(2) / G(3)
      G(2)= G(4) / G(3)
      DO 24 J1=1,N
      K=K1+J1
      K2=K+
      MD
      L=L1+J1
      L2=L+MD
      G(3)=HTRUE(K)
      HTRUE(K)= H(L)+ G(2)*HTRUE(K2)-G(1)*HTRUE(K)
      HTRUE(K2)= H(L2)- G(1)*HTRUE(K2)-G(2)*G(3)
24 CCNTINUE
25 CONTINUE
I=0
      CALL NPNSMX (HTRUE(K1+1),HTRUE(K1+1),N,NC,I,MD,NC,1)
      HMO30665
      HMO30666
      HMO30667
      HMO30668
      HMO30669
      HMO30670
      HMO30671
      HMO30672
      HMO30673
      HMO30674
      HMO30675
      HMO30676
      HMO30677
      HMO30678
      HMO30679
      HMO30680
      HMO30681
      HMO30682
      HMO30683
      HMO30684
      HMO30685
      HMO30686
      HMO30687
      HMO30688
      HMO30689
      HMO30690
      HMO30691
      HMO30692
      HMO30693
      HMO30694
      HMO30695
      HMO30696
      HMO30697
      HMO30698
      HMO30699
      HMO30700
      HMO30701
      HMO30702

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S W E E P X S U B R O U T I N E

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```

31 GOTO (26,32),NC
26  DO 29 J=1,N
      L1=(J-1)*MD
      L2=K1+J
      DO 29 I=1,N
          L=L1+I
          IF (I-INDEX) 28,27,28
          U(L)=0.
27   GOTO 29
28   K=K1+
      U(L)=U(L)-H(K)*US(L2)
29   CONTINUE
30   RETURN
32   DO 35 I=1,N
      L1=MD*NC*(I-1)
      L2=K1+
      J=L2+MD
      DO 35 J1=1,N
          L=L1+J1
          K3=L+MD
          IF (J1-INDEX) 34,33,34
          U(L)=0.
          U(K3)=0.
35   GOTO 35
34   K=K1+J1
      K2=K+MD
      U(L)=U(L)-H(K)*US(L2)+H(K2)*US(L2)-H(K)*US(J)
      U(K3)=U(K3)-H(K2)*US(L2)+H(K)*US(J)
      CONTINUE
35   GOTO 30
END(1,0,0,0,0,0,1,0,0,0,0,0,0,0,0,0)

```

S W E E P X S U B R O U T I N E

2/20/63

STORAGE NOT USED BY PROGRAM

	DEC	OCT	DEC	OCT
744	01350		32561	77461

STORAGE LOCATIONS FOR VARIABLES APPEARING IN DIMENSION AND EQUIVALENCE STATEMENTS

	DEC	OCT	DEC	OCT	DEC	OCT
G	743	01347				

STORAGE LOCATIONS FOR VARIABLES NOT APPEARING IN COMMON, DIMENSION, OR EQUIVALENCE STATEMENTS

	DEC	OCT	DEC	OCT	DEC	OCT	DEC	OCT
I	739	01343	J1	738	01342	J	737	01341
K2	735	01337	K3	734	01336	K	733	01335
L2	731	01333	L	730	01332	H	729	01331

LOCATIONS FOR OTHER SYMBOLS NOT APPEARING IN SOURCE PROGRAM

	DEC	OCT	DEC	OCT	DEC	OCT	DEC	OCT
I1	706	01302	2)	692	01264	3)	695	01267
9)	703	01277	C1G0	710	01306	C1G1	711	01307
C1G4	713	01311	C1G5	714	01312	C1G6	715	01313
C1G8	717	01315	C1G9	718	01316	C1201	719	01317
C1203	721	01321	C1204	722	01322	C1205	723	01323
C1207	725	01325	C1208	726	01326	C1209	727	01327
D110	551	01047	D112	565	01065	D1206	207	00317
D1201	525	01015	D121C	680	01250	D140R	496	00760
D1416	589	01115						

LOCATIONS OF NAMES IN TRANSFER VECTOR

	DEC	OCT	DEC	OCT	DEC	OCT
NPNRMX	0	000000				

S W E E P X S U B R O U T I N E

2/20/63

ENTRY POINTS TO SUBROUTINES NOT OUTPUT FROM LIBRARY

NPNRMX

EXTERNAL FORMULA NUMBERS WITH CORRESPONDING INTERNAL FORMULA NUMBERS AND OCTAL LOCATIONS

	EFN	IFN	LOC	EFN	IFN	LOC	EFN	IFN	LOC		
6	10	00276	8	12	00311	9	15	00341	10	19	00363
11	21	00373	12	29	00442	13	30	00462	14	32	00472
15	33	00503	16	35	00506	17	36	00512	18	39	00532
19	41	00543	20	44	00603	21	45	00626	22	48	00633
23	52	00674	24	60	00753	25	61	00761	31	65	01016
26	66	01020	27	72	01062	28	74	01066	29	76	01102
30	77	01116	32	79	01122	33	87	01200	34	90	01206
35	94	01251									

CENTER OF PRESSURE SUBROUTINE

12/04/62

```

SUBROUTINE CENTER ( A )
      DIMENSION NOP(124), Q(10), X(50), Y(50), ATTIT(50,2), CZRE(50,2),
     1          HADD(50,2), LL(50), LH(50), CM1N(50,2), HR(50,2),
     2          NCPT(50), DELY(50), ZI(50,10),
     3          A(50,2), CL(2), CN(2), CZ(2), TCCP(2), TSOP(2)
      EQUIVALENCE (NOP(14),NQ),
     1          (NOP(17),NRC), (NOP(23),NEXT1), (LM,X), (LL,Y),
     1          (NOP(24),TFL2), (NOP(24),TFL1),
      COMMON NOP,X,Y,NTAPE2,NTAPE3,NTAPE4,NTAPES,NTAPE5,CBAR,
     1          FLEX,CAPS,CAPB,CAPT,CAPN,SHALS,CAPXO,CIOKR,CAPZ,CAPHD,Q,
     2          MAXR,ATT1T,CZRE,CN1N,HR,HADD,MSTRP,NCPT,DELY,Z1,MAXQ,NC,
     3          NCNRC
      200 FORMAT (1H0 35X, 24HAERODYNAMIC COEFFICIENTS / 1H0 11X, 5HCLZ =
     1          1E16.8, 11X, 5HCLM = 1E16.8, 11X, 5HCL = 1E16.8 / 1H0
     2          5X, 47HTOTAL CHORDWISE CENTER OF PRESSURE (XBAR-X0) /
     3          7HCBAR = 1E16.8 / 1H0 5X, 26H TOTAL SPANWISE CENTER OFH031189
     4          28H PRESSURE YBAR/S = 1E16.8 / 1H0 19X,
     5          6H STRIP 13X, 8HCLC/CAVE 13X, 1SHLOCAL CHORDWISE
     6          3H CP )
      201 FORMAT ( 1H 16X, 11T, 2E26.8 )
      202 FORMAT (1H0 30X, 24HAERODYNAMIC COEFFICIENTS / 4H0C2-
     1          2E15.8, 6H1 CM= 2E15.8, 6H1 CL= 2E15.8,
     2          1H1 / 1H0 5X, 36HTOTAL CHORDWISE CENTER OF PRESSURE
     3          18H (XBAR-X0)/CBAR = 2E16.8, 1H1 / 1H0 5X, 6H TOTAL
     4          48H SPANWISE CENTER OF PRESSURE
     5          2E16.8, 1H1 / 1H0 9H STRIP 16X, 8HCLC/CAVE 35X,
     6          1SHLOCAL CHORDWISE CP )
      204 FORMAT (1H 11T, 2E20.8, 1H1 5X, 2E20.8, 1H1)
      DO 206 N=1,NC
     C2(N)=0.
     CL(N)=0.
     CM(N)=0.
     DO 205 I=1,NRC

```

CENTER OF PRESSURE SWINGOUT LINE

12/04/62

CENTER OF PRESSURE SUBROUTINE

```

CZ(IN)=CZ(IN)+A(1, N)
CL(N)=CL(N)+Y(1)*A(1, N)
205   CM(N)=CM(N)+(X(1)-CAPX0)*A(1, N)
      CL(N)=CL(N)/SMALS
      CM(N)=-CM(N)/CBAR
      GOTO 210
IF (NC-1) 207,207,208
207   TCCP(1)=-CM(1)/CZ(1)
      TSCP(1)= CL(1)/CZ(1)
      WRITE OUTPUT TAPE NTAPE3, 200, CZ(1),CM(1),CL(1), TSCP(1), TCCP(1),
      GOTO 210
      CD=CZ(1)*2+CZ(2)*2
      TCCP(1)=-(CM(1)*CZ(1)+CM(2)*CZ(2)) / CD
      TCCP(2)=-(CM(2)*CZ(1)-CM(1)*CZ(2)) / CD
      TSCP(1)= (CL(1)*CZ(1)+CL(2)*CZ(2)) / CD
      TSCP(2)= (CL(2)*CZ(1)-CL(1)*CZ(2)) / CD
      WRITE OUTPUT TAPE NTAPE3, 202, CZ(1),CM(1),CL(1),
      1          CL(2),TCCP(1),TCCP(2),TSCP(1),
      2          TSCP(2)
210   L=0
      IF (NEXIST) 212,212,211
211   L=NEXIST
212   DO 217  I=1,NSTRP
        L1=L+1
        L =L1+NCPT(1))-1
        DO 214  N=1,NC
          CM(N)=0-
          CZ(N)=0-
        L2=0
        DO 213  J=1,L
          L2=L2+1
          CM(N)=CM(N)+Z(I,J,L2)*A(J,N)
          CZ(N)=CZ(N)+A(J,N)
        214  CL(N)=-CZ(N)/SMALS /
          DELY(I)

```

CENTER OF PRESSURE SUBROUTINE

12/04/62

```
IF (NC-1)          216,216,215
215 CD=CZ(1)*2+CZ(2)*2
CE=CM(2)*CZ(1)-CM(1)*CZ(2)
CM(1)=(CM(1)*CZ(1)+CM(2)*CZ(2)) / CD
CM(2)= CE/CD
WRITE OUTPUT TAPE NTAPE3, 204, I, CL(1), CL(2), CM(1), CM(2)
GOTO 217
216 CM(1)=CM(1) / CZ(1)
WRITE OUTPUT TAPE NTAPE3, 201, I, CL(1), CM(1)
217 CONTINUE
RETURN
END(1,0,0,0,0,0,0,1,0,0,0,0,0,0)
```

HM031246
HM031247
HM031248
HM031249
HM031250
HM031251
HM031252
HM031253
HM031254
HM031255
HM031256
HM031257
HM031258
HM031259

CENTER OF PRESSURE SUBROUTINE

12/04/62

DEC	OCT	DEC	OCT
518 01006		31305	75111

STORAGE LOCATIONS FOR VARIABLES APPEARING IN COMMON STATEMENTS

DEC	OCT	DEC	OCT	DEC	OCT	DEC	OCT
ATIT1 32409	77231	C10XR 32423	77247	CAPH0 32421	77245	CAPH1 32426	77254
CAPN 32426	77252	CAPS 32429	77255	CAPT 32427	77253	CAPX0 32424	77250
CAPZ 32422	77246	CBAR 32431	77257	CN1N 32209	76721	CZRE 32209	77065
DELY 31858	76162	FLEXK 32430	77256	HADD 32009	76411	HR 32109	76555
LH 32537	77431	LL 32487	77347	MAX0 31308	75114	MAXR 32410	77232
NCNRC 31306	75112	NCPT 31908	76244	NC 31307	75113	NEST 32549	77445
MOP 32561	77461	NQ 32548	77444	NRC 32545	77441	NSTRP 31909	76245
NTAPE2 32437	77265	NTAPE3 32436	77264	NTAPE4 32435	77263	NTAPES 32434	77262
NTAPE6 32433	77261	NTAPE8 32432	77260	Q 32420	77244	SMALS 32425	77251
TITL1 32439	77433	TITL2 32538	77432	X 32537	77431	Y 32487	77347
ZI 31808	76100						

STORAGE LOCATIONS FOR VARIABLES APPEARING IN DIMENSION AND EQUIVALENCE STATEMENTS

DEC	OCT	DEC	OCT	DEC	OCT	DEC	OCT
CL 517	01005	CM 515	01003	CZ 513	01001	TCCP	511 00777
TSCP 509	00775						

STORAGE LOCATIONS FOR VARIABLES NOT APPEARING IN COMMON, DIMENSION, OR EQUIVALENCE STATEMENTS

DEC	OCT	DEC	OCT	DEC	OCT	DEC	OCT
CD 507	00773	CE 506	00772	I 505	00771	LL 504	00770
L2 503	00767	L 502	00766				

SYMBOLS AND LOCATIONS FOR SOURCE PROGRAM FORMAT STATEMENTS

EFN	LOC	EFN	LOC	EFN	LOC	EFN	LOC
8168 200	00753	8169 201	00646	816A 202	00641	816C 204	00532

CENTER OF PRESSURE SUBROUTINE

12/04/62

LOCATIONS FOR OTHER SYMBOLS NOT APPEARING IN SOURCE PROGRAM

	DEC	OCT	DEC	OCT	DEC	OCT	DEC	OCT	
1)	493	00755	2)	329	00511	3)	333	00515	
9)	492	00754	A)101	316	00474	C)160	497	00761	
C)100	499	00763	C)101	500	00764	C)102	501	00765	
D)508	206	00316					D)1408	207	00317

LOCATIONS OF NAMES IN TRANSFER VECTOR

(FIL)	DEC	OCT	(STH)	DEC	OCT	DEC	OCT
				0	00000		

ENTRY POINTS TO SUBROUTINES NOT OUTPUT FROM LIBRARY

(FIL) (STH)

EXTERNAL FORMULA NUMBERS WITH CORRESPONDING INTERNAL FORMULA NUMBERS AND OCTAL LOCATIONS

EFN	IFN	LOC	EFN	IFN	LOC	EFN	IFN	LOC
205	18	00052	206	20	00067	207	22	00104
210	34	00236	211	36	00244	212	37	00246
214	48	00353	215	50	00374	216	57	00444

11/30/62

SUBROUTINE LOADS
DIMENSION NORA(24), Q(10), X(50), Y(50), ATT1(50,2), CZRE(50,2),
1 HADD(50,2), LL(50), LH(50), CNIN(50,2), HR(50,2), HMO31262
2 NCPT(50), DLY(50), ZI(50,10) HMO31263
DIMENSION A(50,100), B(50,100), C(50,2), D(50,2), H(50,2),
1 F(50,2), FR(50,2), HF(50,2), HE(50,2), FA(50,2), HMO31264
2 FFR(50,2), WCHX(50,2), ZZ(2), DT(2), DD(2), HMO31265
3 SHEAR(20,50), FMOM(20,50), TORQU(20,50), LON(50), HMO31266
4 LHIGN(50), Z(2), HMO31267
5 EQUIVALENCE (INOP(14), NO), (INOP(13),NEXT), (LH,X), (LL,Y),
1 (INOP(17),NRC), (INOP(23),TITLE), (INOP(24),TITLE2), HMO31268
6 (INOP(17),NRC), (INOP(23),TITLE), (INOP(24),TITLE2), HMO31269
7 C0NNCN NOP, X, Y, NTAPE2, NTAPE3, NTAPE5, NTAPE6, NTAPE8, HMO31270
8 CBAR, FLEX, CAPS, CAPH, CAPT, CAPN, SMAL, CAPD, CLKRM, HMO31271
9 *CAPZ, CAPHO, Q, MAXR, ATT1, CZRE, CNIN, HR, HADD, HMO31272
10 NSTRP, NCPT, DELY, ZI, MAXQ, NC, NCNR, A, B, C, D, H, HMO31273
11 F, FR, HF, HI, FA, FFR, WCHX, ZZ, DT, DD, SHEAR, FMOM, HMO31274
12 TORQU, LOW, HIGH, DOEN, DIMAG, DREAL, IQ, I, J, L, NWAT, HMO31275
13 LHIGN HMO31276
14 60 FORMAT (1H1 35X, 25H SHEAR COEFFICIENT MATRIX)
15 61 FORMAT (1H0 35X, 26H MOMENT COEFFICIENT MATRIX)
16 62 FORMAT (1H0 35X, 26H TORQUE COEFFICIENT MATRIX)
17 63 FORMAT (1H1 27X, 40H LOADS FOR CONSTANT ROOT ANGLE OF ATTACK)
18 64 FORMAT (1H1 34X, 28H LOADS FOR TRIMMED CONDITION)
19 65 FORMAT (1H1 30X, 36H LOADS FOR CONSTANT LIFT COEFFICIENT)
20 66 FORMAT (1H0 10X, 22H AERODYNAMIC LIFT (2)= 1E18.8 / 1H0 6X,
21 26H INCREMENTAL PITCH ANGLE = 1E18.8)
22 67 FORMAT (1H 11X, 113, 1E20.8, 27X, 113, 1E20.8)
23 68 FORMAT (1H 113, 2X, 2E18.8, 2H 1 7X, 143, 2X, 2E18.8, 2H 1)
24 69 FORMAT (1H0 6X, 37H FINAL AERODYNAMIC FORCE DISTRIBUTION 1 7X,
25H TOTAL FORCE DISTRIBUTION)
26 1 25H TOTAL FORCE DISTRIBUTION)
27 410 FORMAT (1H0 31X, 20H DYNAMIC PRESSURE = 1E16.8)
28 411 FORMAT (1H0 10X, 22H AERODYNAMIC LIFT (2)= 2E18.8, 1H1 / 1H0 6X,
29 1 26H INCREMENTAL PITCH ANGLE = 2E18.8, 1H1)
30 412 FORMAT (1H0 17X, 17H DEFORMATION MODE 30X, 17H TOTAL DEFLECTION
31 1 5 H MODE)
32 413 FORMAT (1H0 37X, 22H SHEAR AT LOAD STATIONS / (1H 6E18.8)
33 414 FORMAT (1H0 36X, 24H MOMENT AT LOAD STATIONS / (1H 6E18.8)
34 HMO31297 HMO31298

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415 FORMAT (1HO 36X, 23HTORQUE AT LOAD STATIONS / (1H 6E18.8) )
416 FORMAT (18I4)
417 FORMAT (16E12.8)

REWIND NTAPE4
REWIND NTAPES
REWIND NTAPE8

418 IF (INOP(16)) 450,450,420
C READ IN (V/F), (M/F), (T/F) MATRICES.
420 DO 432 I=1,3
      READ INPUT TAPE NTAPE2, 416, NVMT
      READ INPUT TAPE NTAPES2, 416, (ILOWIJ,J=LHIGH(J)),J=1,NVMT
DO 424 J=1,NVMT
  DO 422 K=2,NRC
    A(J,K)=0-
    HALOW(I,J)
    L=LHIGH(I,J)
    READ INPUT TAPE NTAPE2, 417, (A(J,K),K= M,L )
    GOTO (426,428,430),I
426 WRITE OUTPUT TAPE NTAPE3, 400
DO 427 J=1,NVMT
  DO 427 K=1,NRC
    SHEAR(I,J,K)=A(I,J,K)
  NVMT=NVMT
  GOTO 432
428 WRITE OUTPUT TAPE NTAPE3, 401
DO 429 J=1,NVMT
  DO 429 K=1,NRC
    FMON(I,J,K)=A(I,J,K)
  NVMT=NVMT
  GOTO 432
430 WRITE OUTPUT TAPE NTAPE3, 402
DO 431 J=1,NVMT
  DO 431 K=1,NRC
    TORQU(I,J,K)=A(I,J,K)
  CALL MRINT (A,NVMT,NRC,MAXR,NTAPE3)
432
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5 COMPUTE (H) COLUMN MATRIX
450 DO 454 I=1,NRC
      DB 454
      H(I,J)=CAPHB*HR(I,J)+CAPHA*ADD(I,J)+CAPT*ATTIT(I,J)
      H(I,J)=CAPHB*HR(I,J)+CAPHA*ADD(I,J)+CAPT*ATTIT(I,J)
      C READ (IN) (CH) FROM JARE NTAPES INTO A AND COMPUTE (FR)
      READ TAPE NTAPES, 11AT1,J,J=1,NCNRC ) * 1=1,NRC
      CALL PMULTD (A,NOP(7), H,NOP(7),C,NRC,NRC, 1,MAXR,MAXR )
      DO 459 J=1,NC
      DB 456 I=1,NRC
      SFR(I,J)=CAPS+C(I,J) / CBAR
      IF ( NOP(12) ) 457,459,457
      DB 458 I=1,NRC
      SFR(I,J)=FFR(I,J) + CAPS+CZRE(I,J)
      459 CONTINUE
      IF ( NOP(12)*NOP(3) ) 460,478,460
      460 CALL PMULTD (A,NOP(7),X,O,WCHX,NRC,NRC, 1,MAXR,MAXR )
      Z(1)=CAPZ
      Z(2)=0.
      IF ( NOP(3) ) 462,478,462
      DO 464 I=1,NRC
      C(I,J) = CAPHB*HR(I,J)+CAPH*HADD(I,J)
      CALL PMULTD (A,NOP(7),C,NOP(7), D ,NRC,NRC, 1,MAXR,MAXR )
      DO 476 J=1,NC
      ZZ(J)=0.
      DB 470 I=1,NRC
      ZZ(J)=ZZ(J)+ D(I,J)
      IF ( NOP(12) ) 472,474,472
      DO 474 I=1,NRC
      ZZ(J) = ZZ(J)+ CZRE(I,J)

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476 ZZ(J)=ZZ(J)+CAPS / CBAR  
478 SENSE LIGHT 0  
C READ FLEXIBILITY. AA=MATRIX FROM NTAPE4 INTO B.  
READ TAPE NTAPE4. ((B(I,J),J=1,NRC),I=1,NRC)  
479 IF 4NOP(11) ) 481,482,481  
481 SENSE LIGHT 1  
482 IF JNOP(12) ) 483,484,483  
483 SENSE LIGHT 2  
484 IF INOP(13) ) 485,486,485  
485 SENSE LIGHT 3  
486 DO 554 I Q=1,NC  
554 DO 488 J=1,NC  
488 DO 488 I=1,NRC  
      FR(I,J) = Q(IQ) * FFR(I,J) + CAPN=CNIN(I,J)  
C READ (A) FROM NTAPE8 INTO A ARRAY  
READ TAPE NTAPE8. ((A(I,J),J=1,NRC),I=1,NRC)  
IF 1 SENSE LIGHT 1 ) 490,492  
490 SENSE LIGHT 1  
CALL PMULTD (B,I,FR,NOP(17),D,NRC,NBC,1,MAXR,MAXR)  
CALL PMULTD (A,NOP(17),D,NOP(17),HF,NRC,NRC,1,MAXR,MAXR)  
C READ (B) MATRIX INTO A. ((A(I,J),J=1,NRC),I=1,NRC)  
492 READ TAPE NTAPE8.  
CALL MMULTD (A,NOP(17),FR,NOP(17),F,NRC,NRC,1,MAXR, MAXR )  
IF 1 SENSE LIGHT 1 ) 514,494  
494 CALL MMULTD (A,NOP(17),MCX,NOP(17),D, NRC,NRC,1,MAXR,MAXR)  
DO 496 J=1,NC  
      HN031375  
      HN031376  
      HN031377  
      HN031378  
      HN031379  
      HN031380  
      HN031381  
      HN031382  
      HN031383  
      HN031384  
      HN031385  
      HN031386  
      HN031387  
      HN031388  
      HN031389  
      HN031390  
      HN031391  
      HN031392  
      HN031393  
      HN031394  
      HN031395  
      HN031396  
      HN031397  
      HN031398  
      HN031399  
      HN031400  
      HN031401  
      HN031402  
      HN031403  
      HN031404  
      HN031405  
      HN031406  
      HN031407  
      HN031408  
      HN031409  
      HN031410  
      HN031411  
      HN031412
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 DT(J)=0.
 DB(J)=0.
 DB 496 I=1,NRC
 DT(J)=DT(J)+F(I,J)-CAPN=CN1N(I,J)
 DD(J)=DD(J)+D16,J)
 IF (SENSE LIGHT 2) 498,500
 498 SENSE LIGHT2
 GOTO 502
 500 Z(1)=ZZ(1)*Q(IQ) 506,504,506
 Z(2)=ZZ(2)*Q(IQ)
 502 4F (NC-1) 506,504,506
 504 DT(1) = (DT(1)-Z(1))/ (Q(IQ)*CAPS*DD(1)) / CHAR
 DO 505 I=1,NRC
 505 F(I,1)=F(I,1)-DT(1)*D(I,1)*Q(IQ)*CAPS/CBAR
 GOTO 511
 506 DREAL = (DT(1)- Z(1))/ (DD(1)+ (DT(2)- Z(2))*DD(2))
 DIMAG = (DT(2)- Z(2))*DD(1) - (DT(1)- Z(1))*DD(2)
 DDEN = (DD(1)**2 + DD(2)**2)
 DT(1)= DREAL*CBAR / (DDEN*Q(IQ)*CAPS)
 DT(2)= DIMAG*CBAR / (DDEN*Q(IQ)*CAPS)
 510 I=1,NRC
 F(I,1)=F(I,1)-(Q(IQ)*CAPS/CBAR)* (DT(1)*D(I,1)-D(I,2))
 510 F(I,2)=F(I,2)-(Q(IQ)*CAPS/CBAR)* (DT(1)*D(I,2)+D(I,2))
 511 CALL PMULTD (B,O,F,O,HF,NRC,NRC,1,MAXR,MAXR)
 DO 512 J=1,NC
 DO 512 I=1,NRC
 512 H(I,J) = FTEKK*HF(I,J) + H(I,J) - DT(J)*X(I)
 GOTO 518
 514 SENSE LIGHT 1

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CALL PMULTID (860,F,NOP(7),HI,NRC,1,MAXR,MAXR,MAXR)
DO 516 J=1,NC
  DO 516 I=1,NRC
    HI(I,J)=FLEXK*HI(I,J)+H(I,J)
516 DO 520 J=1,NC
  DO 520 I=1,NRC
    HF(I,J)=FLERK*HF(I,J)
    FA(I,J)=F(I,J)-CAPN*CN1N6(I,J)
520 IF ISENSE LIGHT 1 1 524,526
  SENSE LIGHT 1
  WRITE OUTPUT TAPE NTAPB3, 403
  GO TO 532
524 IF ISENSE LIGHT 2 1 528,530
  SENSE LIGHT 2
  WRITE OUTPUT TAPE NTAPB3, 404
  GO TO 532
530 WRITE OUTPUT TAPE NTAPB3, 405
532 WRITE OUTPUT TAPE NTAPB3, 410, Q(10)
  IF ISENSE LIGHT 1 1 534,536
  SENSE LIGHT 1
  GO TO 542
536 IF INC=1J 540,540,538
  WRITE OUTPUT TAPE NTAPB3, 411, ( Z(J),J=1,NC), (DT(J),J=1,NC)
  GO TO 542
540 WRITE OUTPUT TAPE NTAPB3, 406, Z(1), DT(1)
542 WRITE OUTPUT TAPE NTAPB3, 412
  IF INC=1) 546,544,546
  WRITE OUTPUT TAPE NTAPB3, 407,
  GO TO 548

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HH031451 HH031452
HH031453 HH031454
HH031455 HH031456
HH031457 HH031458
HH031459 HH031460
HH031461 HH031462
HH031463 HH031464
HH031465 HH031466
HH031467 HH031468
HH031469 HH031470
HH031471 HH031472
HH031473 HH031474
HH031475 HH031476
HH031477 HH031478
HH031479 HH031480
HH031481 HH031482
HH031483 HH031484
HH031485 HH031486
HH031487 HH031488

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546 WRITE OUTPUT TAPE NTAPB3.
I 408. ((I, (WF(I,J), J=1,2), I, (HI(I,J)),
J=1,2)), I=1, NRC)
HNO31489
HNO31490
HNO31491
HNO31492
HNO31493
HNO31494
HNO31495
HNO31496
HNO31497
HNO31498
HNO31499
HNO31500
HNO31501
HNO31502
HNO31503
HNO31504
HNO31505
HNO31506
HNO31507
HNO31508
HNO31509
HNO31510
HNO31511
HNO31512
HNO31513
HNO31514
HNO31515
HNO31516
HNO31517
HNO31518
HNO31519
HNO31520
HNO31521

548 WRITE OUTPUT TAPE NTAPE3. 409
IF (NC-1) 551. 550. 551
550 WRITE OUTPUT TAPE NTAPB3. 407. ((I, FA(I,10,I,F(I,1)), I=1, NRC)
GOTO 552
551 WRITE OUTPUT TAPE NTAPE3. 408. ((I, (FA(I,J), J=1,2), I, (F(I,J)),
J=1,2)), I=1, NRC)
I

552 IF (NOP(16)) 554. 554. 553
553 CALL PMULD(SHEAR, O_F, NOP(7), D, NVMS, NRC, 1, MAXQ, MAXR, MAXR)
WRITE OUTPUT TAPE NTAPB3. 413. ((D(I,J), J=1, NC), I=1, NVMS)
CALL PMULD (FMOM, O_F, NOP(7), D, NVMM, NRC, 1, MAXQ, MAXR, MAXR)
WRITE OUTPUT TAPE NTAPE3. 414. ((D(I,J), J=1, NC), I=1, NVMM)
CALL PMULD (TORGU,O_F, NOP(7), D, NVWT, NRC, 1, MAXQ, MAXR, MAXR)
WRITE OUTPUT TAPE NTAPB3. 415. ((D(I,J), J=1, NC), I=1, NVWT)

554 CONTINUE

REINIT NTAPES
IF (ISENSE LIGHT 1) 556. 557
557 IF (ISENSE LIGHT 2) 566. 564
558 IF (ISENSE LIGHT 2) 558. 566
559 GENSE LIGHT 2
GOTO 486

566 IF (SENSE LIGHT 3) 562. 564
562 SENSE LIGHT 3
GOTO 486

564 RETURN
END(1,0,0,0,0,0,0,0,1,0,0,0,0,0,0)

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STORAGE NOT USED BY PROGRAM

	DEC	OCT		DEC	OCT
1398	02566			17188	41444

STORAGE LOCATIONS FOR VARIABLES APPEARING IN COMMON STATEMENTS

	DEC	OCT		DEC	OCT		DEC	OCT	
A	31305	75111		ATT1T	32409	77231		DBC	OCT
CARM0	32421	77245		CAPH	32426	77254	CAPPN	32426	77252
CART	32427	77253		CAPX0	32424	77250	CAPZ	32422	77246
CHIN	32209	76721	C	21305	51471		CZRE	32309	77065
09	20299	47513	DELY	31858	76162	DIMAG	17245	41535	
B	21205	51325	DT	20301	47515	FA	20605	50175	
FLEXK	32430	77256	FROM	19297	45541	FR	20905	50651	
HAD0	32609	76411	HF	20805	50505	HIGH	17247	41537	
MR	322109	76555	H	21105	51161	IQ	17243	41533	
J	17241	41531	LHIGH	17238	41526	LH	32537	77431	
BON	17297	41621	L	17240	41530	MAXQ	31308	75114	
NCBRC	31306	75112	NCPT	31908	76244	NC	31307	75113	
NBP	32561	77461	NQ	32548	77444	NRC	32545	77441	
NTARE2	32437	77265	NTAPE3	32436	77264	NTAPE4	32435	77263	
NTARE6	32433	77261	NTARE8	32432	77260	NTAPE7	17239	41527	
SHEAR	20297	47511	SMALS	32425	77251	TITL1	32539	77433	
TORQU	18297	43671	WCXH	20405	47665	TITL2	32538	77432	
Z1	31808	76100	Z	20303	47517	X	32537	77431	
						Z	20305	47521	

STORAGE LOCATIONS FOR VARIABLES NOT APPEARING IN COMMON, DIMENSION, OR EQUIVALENCE STATEMENTS

	DEC	OCT		DEC	OCT		DEC	OCT
M	1397	02565	NVMM	1396	2554	NVMS	1395	02563

SYMBOLS AND LOCATIONS FOR SOURCE PROGRAM FORMAT STATEMENTS

	EFN	LOC		EFN	LOC		EFN	LOC
81CC	400	02544	81CH	401	02534	81CI	402	02524
81CK	404	02502	81CL	405	02471	81CM	406	02457
81CB	408	02425	81CP	409	02413	81CQ	410	02371

8)CS 412 02335
 8)DO 416 02261 8)CT 413 02317
 8)CI 417 02257 8)CU 414 02305
 / 8)CV 415 02273

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LOCATIONS FOR OTHER SYMBOLS NOT APPEARING IN SOURCE PROGRAM

	DEC	OCT	DEC	OCT	DEC	OCT	DEC	OCT
1)	1381	02545	2)	1196	02242	3)	1191	02247
C)G1	1385	02551	C)G2	1386	02552	C)G3	1387	02553
C)201	1389	02555	C)203	1390	02556	C)204	1391	02557
C)206	1393	02561	C)207	1394	02562	D)24A	592	01740
D)505	65	00101	E)1P	432	00660			

LOCATIONS OF NAMES IN TRANSFER VECTOR

	DEC	OCT	DEC	OCT	DEC	OCT	DEC	OCT
MMULTD	8	000010	MPRINT	5	00005	(FILE)	4	00004
(RTN)	2	00002	(RWT)	0	00000	(STH)	3	00003
(TSB)	1	00001					(KLR)	7 00007
							(TSB)	6 00006

ENTRY POINTS TO SUBROUTINES NOT OUTPUT FROM LIBRARY

	PMULTD (TSB)	MPRINT (FILE)	(RLR)	(RTN)	(RWT)	(STH)	(TSB)

EXTERNAL FORMULA NUMBERS WITH CORRESPONDING INTERNAL FORMULA NUMBERS AND OCTAL LOCATIONS

EFN	IFN	LOC	EFN	IFN	LOC	EFN	IFN	LOC
420	29	00034	422	41	00103	424	44	00114
427	53	00203	428	56	00220	429	59	00244
431	65	00305	432	66	00317	450	68	00330
456	82	00461	457	84	00472	458	85	00472
460	88	00513	462	93	00535	464	95	00553
472	103	00651	474	104	00651	476	105	00663
481	115	00727	482	116	00730	483	117	00732
485	119	00735	486	120	00736	488	123	00760
492	137	01056	494	147	01122	496	154	01165
500	158	01204	502	160	01212	504	161	01217

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506	165	01247	510	172	01350	511	173	01371	512	177	01416
514	179	01437	516	184	01472	518	185	01505	520	188	01526
524	190	01544	526	193	01552	528	194	01554	530	197	01562
532	198	01566	534	201	01577	536	203	01601	538	204	01606
540	213	01631	542	215	01641	544	217	01652	546	223	01677
548	235	01741	550	237	01752	551	245	01777	552	257	02040
553	258	02044	554	285	02212	557	288	02223	556	289	02226
558	290	02230	566	292	02232	562	293	02234	564	295	02236

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SUBROUTINE DERIV
 DIMENSION NOP(24), Q(10), X(50), ATTIT(50,2), CZRE(50,2),
 1 HADD(50,2), LL(50), LH(50), CN1N(50,2), HR(50,2),
 2 NCPT(50), DELY(50), ZI(50,10)
 DIMENSION A(50,100), B(50,100), C(50,2), D(50,2), E(50,2)
 EQUIVALENCE (NOP, NQ), (NOP(13),NEXT), (LH-X), (LL-Y),
 1 (NQ(17),NRC), (NOP(23),TITL1), (NQ(24), TITL2)
 COMMON NOP,X,Y,NTAPE2,NTAPE3,NTAPE4,NTAPE5,NTAPE6,NTAPE8,CBAR,
 1 FLEXK,CAPS,CAPH,CAPT,CAPN,SMALS,CAPXO,C10KR,CAP2,CAPH,Q,
 2 MAXR,ATTIT,CZRE,CN1N,HR,HADD,NSTRP,NCTP,DELY,ZI,MAXQ,NC,
 3 NCNRC,A,B,C,D,H,E,NX,TRASH
 6 FORMAT(1H1381H)20HINITIAL COEFFICIENTS)
 7 FORMAT(1H1341H)133HAERODYNAMIC STABILITY DERIVATIVES)
 8 FORMAT(1H1331H)129HTHERMAL STABILITY DERIVATIVES)
 9 FORMAT(153H0*****DISTRIBUTED FORCE COEFFICIENTS (DYNAM
 1 14HIC PRESSURE = 1E15.8, 1H) /)
 10 FORMAT(1H1371H)120HINERTIAL DERIVATIVES)
 11 FORMAT(1H 28X, 36HADDITIONAL DEFLECTION MODE (W/REF HI) /)
 12 FORMAT(1H 36X, 5H REAL // (1H 24X, 116.3X, 1E16.0))
 13 FORMAT(1H 35X, 7HCOMPLEX // (1H 15X, 116. 3X, 2E18.8, 1H))
 REWIND NTAPE4
 REWIND NTAPES
 REWIND NTAPES
 SENSE LIGHT 0
 NX=0
C TEST FOR OPTION 5,6,7,8,9 AND SET SLS ACCORDINGLY.
 IF (NOP(5)) 24,24,23
 23 SENSE LIGHT 1
 24 IF (NOP(6)) 26,26,25
 25 SENSE LIGHT 2

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26 IF (INOP(8)) 28,28,27  
27 SENSE LIGHT 3  
28 IF (INOP(9)) 30,30,29  
29 SENSE LIGHT 4  
  
C THEN PROCEED TO (C) COMPUTATIONS.  
30 IF (I SENSE LIGHT 1 ) 31,34  
31 SENSE LIGHT 1  
WRITE OUTPUT TAPE NTAPE3, 6  
DO 32 I=1,NC  
32 DO 32 J=1,NRC  
32 D(J,I) = (CAPHO ) *HRC(J,I)  
GOTO 45  
  
34 IF (ISENSE LIGHT 2 ) 35,38  
35 SENSE LIGHT 2  
WRITE OUTPUT TAPE NTAPE3, 7  
DO 36 I=1,NC  
36 DO 36 J=1,NRC  
36 D(J,I) = HACD(J,I)  
GOTO 45  
  
38 IF (ISENSE LIGHT 3 ) 39,42  
39 SENSE LIGHT 3  
WRITE OUTPUT TAPE NTAPE3, 8  
DO 40 I=1,NC  
40 DO 40 J=1,NRC  
40 D(J,I) = ATTIT(J,I)  
GOTO 45  
  
42 IF (I SENSE LIGHT 4 ) 43,67  
43 SENSE LIGHT 4  
WRITE OUTPUT TAPE NTAPE3, 10  
C READ FLEXIBILITY MATRIX FROM TAPE (A)  
READ TAPE NTAPE4, ((AIL,I,J),J=1,NRC),I=1,NRC  
HM031561  
HM031562  
HM031563  
HM031564  
HM031565  
HM031566  
HM031567  
HM031568  
HM031569  
HM031570  
HM031571  
HM031572  
HM031573  
HM031574  
HM031575  
HM031576  
HM031577  
HM031578  
HM031579  
HM031580  
HM031581  
HM031582  
HM031583  
HM031584  
HM031585  
HM031586  
HM031587  
HM031588  
HM031589  
HM031590  
HM031591  
HM031592  
HM031593  
HM031594  
HM031595  
HM031596  
HM031597  
HM031598
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CALL PMULTD ( A,O,CMIN,NOP(7),D,NRC,NRC,1.    MAXR,MAXR,MAXR)
DO 44 I=1,NC
  DO 44 J=1,NRC
    44 E(J,I) = FLEXK*D(J,I) / CBAR

C READ AERO. MATRIX FROM TAPE (W) (CH)
READ TAPE NTAPE5, ((B(I,J),J=1,NCNRC),I=1,NRC)
NX=1
GOTO 50

45 READ TAPE NTAPE5, ((A(I,J),J=1,NCNRC),I=1,NRC)
CALL PMULTD ( A,NOP(7),D,NOP(7),C,NRC,NRC,1, MAXR,MAXR,MAXR)
DO 46 I=1,NC
  DO 46 J=1,NRC
    46 C(J,I)=C(J,I)/CBAR
    IF (SENSE LIGHT 1) 47,50

47 SENSE LIGHT 1
IF (NOP(12)) 50,50,48
48 DO 49 I=1,NC
  DO 49 J=1,NRC
    49 C(J,I)= C(J,I)+CZRE(J,I)

C START COMPUTATIONS FOR EACH DYNAMIC PRESSURE, Q.
50 DO 60 IQ=1,NQ

READ TAPE NTAPE8, ((A(I,J),J=1,NCNRC),I=1,NRC)
IF ( Q(IQ) ) 51,51,53
51 IF ( NX ) 71,71,54
71 DO 52 J=1,NC
  DO 52 I=1,NRC
    52 D(I,J) = C(I,J)
    GOTO 55

53 IF ( NX ) 56,56,54
54 CALL PMULTD ( A,NOP(7),E,NOP(7),C,NRC,NRC,1, MAXR,MAXR,MAXR)
CALL PMULTD ( B,NOP(7),C,NOP(7),D,NRC,NRC,1, MAXR,MAXR,MAXR)
55 READ TAPE NTAPE8, TRASH
      GOTO 57

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56 READ TAPE NTAPE8, ((A(I,J),J=1,NCNRC),I=1,NRC)
    CALL PMULTD ( A,NOP(7),C,NOP(7),D,NRC,NRC,1, MAXR,MAXR )
57 WRITE OUTPUT TAPE NTAPE3, 9, Q(IQ)
    IF (INC-1) 58,58,59
58 WRITE OUTPUT TAPE NTAPE3, 12, (J,D(J,1),J=1,NRC)
    GOTO 70
59 WRITE OUTPUT TAPE NTAPE3, 13, (J,(D(J,1),I=1,NC),J=1,NRC)
    HMO31644
70 CALL CENTER (D)
    HMO31645
60 CONTINUE
    HMO31646
    HMO31647
    HMO31648
    HMO31649
    HMO31650
    HMO31651
    HMO31652
    HMO31653
    HMO31654
    HMO31655
    HMO31656
    HMO31657
    HMO31658
    HMO31659
    HMO31660
    HMO31661
    HMO31662
    HMO31663
    HMO31664
    HMO31665
    HMO31666
    HMO31667
    HMO31668

REWIND NTAPE4
REWIND NTAPES
REWIND NTAPE8
IF (SENSE LIGHT 1 ) 34,61
61 IF ( SENSE LIGHT 2 ) 62,66
62 NOP(6)=NOP(6)-1
63 IF ( NOP(6) )
    IF ( NOP(6) )
        IF ( SENSE LIGHT 2 )
            CALL MREAD (D,NRC,NC,1,0,0,A,MAXR,NTAPE2,NTAPE3 )
            WRITE OUTPUT TAPE NTAPE3, 7
            WRITE OUTPUT TAPE NTAPE3, 11
            IF (INC-1) 64,64,65
64 WRITE OUTPUT TAPE NTAPE3, 12, (I,D(I,1),I=1,NRC)
    GOTO 45
65 WRITE OUTPUT TAPE NTAPE3, 13, (I,(D(I,J),J=1,NC),I=1,NRC)
    GOTO 45
66 IF ( SENSE LIGHT 3 ) 42,67
67 RETURN
END(1,0,0,0;0,C,0,0,0,1,0,0,0,0,0)

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STORAGE NOT USED BY PROGRAM

DEC	OCT
681 01251	21002 51012

STORAGE LOCATIONS FOR VARIABLES APPEARING IN COMMON STATEMENTS

DEC	OCT	DEC	OCT
A 31305 75111	ATLT 32409 77231	B 26305 63301	C1OKR 32423 77247
CAPHC 32421 77245	CAPH 32428 77254	CAPN 32426 77252	CAPS 32429 77255
CAPT 32427 77253	CAPXO 32424 77250	CAPZ 32422 77246	CBAR 32431 77257
CN1N 32209 76121	C 21305 51471	CZRE 32309 77065	DELY 31858 76162
C 21205 51325	E 21104 51160	FLEXK 32430 77256	HADD 32009 76411
HR 32109 76555	H 21105 51161	LH 32537 77431	LL 32487 77347
MAXQ 31308 75114	MAXR 32410 77232	NCNRC 31306 75112	NCPT 311908 76244
NC 31307 75113	NEXST 32549 77445	NOP 32561 77461	NQ 32548 77444
NRC 32545 77441	NSTRP 31909 76245	NTAPE2 32437 77265	NTAPE3 32436 77264
NTAPE4 32435 77263	NTAPES 32434 77262	NTAPE6 32433 77261	NTAPE8 32432 77260
NX 21004 51014	Q 32420 77244	SMALS 32425 77251	TITL1 32539 77433
TITLE2 32538 77432	TRASH 21003 51013	X 32537 77431	Y 32487 77347
ZI 31808 76100			

STORAGE LOCATIONS FOR VARIABLES NOT APPEARING IN COMMON, DIMENSION, OR EQUIVALENCE STATEMENTS

DEC	OCT	DEC	OCT
1 680 01250	J 679 01247		

SYMBOLS AND LOCATIONS FOR SOURCE PROGRAM FORMAT STATEMENTS

EFN	LOC	EFN	LOC	EFN	LOC
816 6 01246	817 7 01240	818 8 01230	819 9 01220		
81A 10 01176	81B 11 01170	81C 12 01156	81D 13 01145		

LOCATIONS FOR OTHER SYMBOLS NOT APPEARING IN SOURCE PROGRAM

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		DEC OCT		DEC OCT		DEC OCT		DEC OCT		DEC OCT	
2)		595	01123	6)		598	01126	LOCATIONS OF NAMES IN TRANSFER VECTOR		ENTRY POINTS TO SUBROUTINES NOT OUTPUT FROM LIBRARY	
CENTER	DEC OCT	6 00006	MULTD	DEC OCT	5 00005	MREAD	OCT 7 00007	(FILE)	DEC 2 00002	(TSB)	OCT 3 00003
(RLR)	(RLR)	4 00004	(RWT)	0 00000	(STH)	1 00001	(TSB)				
CENTER	MULTD		MREAD	(FILE)	(IRLR)	(RWT)	(STH)	(TSB)			
EXTERNAL FORMULA NUMBERS WITH CORRESPONDING INTERNAL FORMULA NUMBERS AND OCTAL LOCATIONS											
EFN	IFN	LOC	EFN	IFN	LOC	EFN	IFN	LOC	EFN	IFN	LOC
23	21	00036	24	22	00037	25	23	00043	26	24	00044
27	25	00050	28	26	00051	29	27	00055	30	28	00056
31	29	00060	32	33	00103	34	35	00116	35	36	00120
36	40	00143	38	42	00155	39	43	00157	40	47	00202
42	49	00214	43	50	00216	44	63	00302	45	73	00345
46	84	00424	47	86	00440	48	88	00445	49	90	00463
50	91	00475	51	100	00530	71	101	00533	52	103	00551
53	105	00563	54	106	00567	55	110	00617	56	113	00625
57	122	00666	58	125	00700	59	131	00721	70	138	00756
60	140	00760	61	145	00773	62	146	00775	63	148	01004
64	154	01035	65	160	01056	66	168	01114	67	169	01117

MATRIX ITERATION SUBROUTINE, REAL OR COMPLEX.

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```

C CALLING SEQUENCE.....
C
C A = MATRIX, DIMENSIONED (MAXR X N) - REAL
C (MAXR X 2*N) - COMPLEX
C NTAPE=UTILITY TAPE, IF + MATRIX IS IN CORE AT A, IF - ITS ON NTAPE
C H = ORDER OF MATRIX
C GUESS=1ST. GUESS VECTOR, DIMENSIONED (MAXR X 1) - REAL
C (MAXR X 2) - COMPLEX
C NGUESS=0, ROUTINE SUPPLIES GUESS VECTOR
C #+1, GUESS CONTAINS EIGEN SOLUTIONS REQUESTED.
C NMODE=NUMBER OF EIGEN SOLUTIONS REQUESTED.
C VECTOR=EIGENVECTORS, DIMENSIONED (MAXR X NMODE) - REAL
C (MAXR X 2*NMODE) - COMPLEX
C (NMODE X 1) - REAL
C (NMODE*2 X 1) - COMPLEX
C
C NITER=NUMBER OF ITERATIONS PER MODE
C NITRSP = MAXIMUM NUMBER OF SINGLE PRECISION ITERATIONS
C EPSP = CONVERGENCE CRITERIA
C IR = ERROR INDICATOR
C US=CHECK EIGENVECTORS, DIMENSIONED (MAXR X NMODE) - REAL
C (MAXR X 2*NMODE) - COMPLEX
C H = WORKING AREA OF CORE, DIMENSIONED (MAXR X (NMODE+2) ) - REAL
C (MAXR X 2*(NMODE+2) ) - COMPLEX
C
C NTAPE1=TAPE NUMBER OF OUTPUT PRINT TAPE
C IF = 0, NO RESULTS WILL BE PRINTED
C
C MAXR = DIMENSIONED NUMBER OF ROWS
C NC = 1, PROBLEM REAL
C = 2, PROBLEM COMPLEX
C
C AIKSEN = AITKEN CONVERGENCE CRITERIA
C NAKSR = NUMBER OF TIMES AIKEN APPLIED IN EACH MODE
C
C
C SUBROUTINE MITER (A, NTAPE, N, GUESS, NGUESS, NMODE, VECTOR,
C EIGVAL, NITER, NITRSP, EPSP, IR, US, H,
C NM031672 HN031673
C NM031674 HN031675
C NM031675 HN031676
C NM031676 HN031677
C NM031677 HN031678
C NM031678 HN031679
C NM031679 HN031680
C NM031680 HN031681
C NM031681 HN031682
C NM031682 HN031683
C NM031683 HN031684
C NM031684 HN031685
C NM031685 HN031686
C NM031686 HN031687
C NM031687 HN031688
C NM031688 HN031689
C NM031689 HN031690
C NM031690 HN031691
C NM031691 HN031692
C NM031692 HN031693
C NM031693 HN031694
C NM031694 HN031695
C NM031695 HN031696
C NM031696 HN031697
C NM031697 HN031698
C NM031698 HN031699
C NM031699 HN031700
C NM031700 HN031701
C NM031701 HN031702
C NM031702 HN031703
C NM031703 HN031704
C NM031704 HN031705
C NM031705 HN031706
C NM031706 HN031707
C NM031707 HN031708
C NM031708 HN031709

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MATRIX ITERATION SUBROUTINE, REAL OR COMPLEX.

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```

2      MAXR, NC, AITKEN, NAKSR, NTAPE1      HMO31709
      DIMENSION A(1), GUESS(1), VECTOR(1), EIGVAL(1), NITER(1), US(1),
      1      H(1), NAKSR(1), B00LT(4)          HMO31710
      6      B00LT(1)=606046652551           HMO31711
      6      B00LT(2)=266346666666060        HMO31712
      6      B00LT(3)=243165312425          HMO31713
      6      B00LT(4)=602330252342          HMO31714
      6      B00LT(5)=602330252342          HMO31715
      6      B00LT(6)=602330252342          HMO31716
      6      B00LT(7)=602330252342          HMO31717
      6      B00LT(8)=602330252342          HMO31718
      3 IF ACCUMULATOR OVERFLOW      3,3
      3 IF DIVIDE CHECK      4,4
C FIND MATRIX AND STORE ON TAPE IF NECESSARY
      4 I=NTAPE
      J2=MAXR*NC*N
      IF ( I ) 5,8,6
      5 I=-1
      REWIND 1
      CO 1, J=1,N
      1 READ TAPE 1, (A(K),K=J,J2,MAXR)
      NTAPE = 1
      GOTO 7
      6 REWIND NTAPE
      DO 2 J=1,N
      2 WRITE TAPE NTAPE, (A(K),K=J,J2,MAXR)
      7 REWIND NTAPE
C DEFINE PROGRAM CONSTANTS AND ZEROS.
      8 MODE=0
      IR=0
      AT=AITKEN**2
      1 IF ( EPSP ) 12,9,12
      9 EPSP = .1E-08
      12 IF ( NGUESS ) 15,13,15
      13 J1=MAXR*(NC-1)

```

MATRIX ITERATION SUBROUTINE: REAL OR COMPLEX.

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```

HMO31747
HMO31748
HMO31749
HMO31750
HMO31751
HMO31752
HMO31753
HMO31754
HMO31755
HMO31756
HMO31757
HMO31758
HMO31759
HMO31760
HMO31761
HMO31762
HMO31763
HMO31764
HMO31765
HMO31766
HMO31767
HMO31768
HMO31769
HMO31770
HMO31771
HMO31772
HMO31773
HMO31774
HMO31775
HMO31776
HMO31777
HMO31778
HMO31779
HMO31780
HMO31781
HMO31782
HMO31783
HMO31784

DO 14 I=1,N
   K=J1+1
   GUESS(K)=0.
   GUESS(I)=1.
14

15 MODE = MODE+1
   NAKSR(MODE)=0
   IGO=1
   NITER(MODE)=0
   K1=NC*MAXR*(IMODE-1)
   K2=K1+1
   K3=NC*(IMODE-1)+1
   K4= NC*MAXR
   K5=K4*NMODE
   K6=K5+K4

MOVE FIRST GUESS INTO POSITION
DO 16 J=1,NC
   J1=MAXR*(J-1)
DO 16 I=1,N
   K=K1+J1+I
   L=J1+I
   H(K)=GUESS(L)
16

17 NAK=0
18 NITER(MODE)=NITER(MODE)+1
   INDEX=0
   CALL MMULTD (A,NC-1,H(K2),NC-1,VECTOR(K2),N,N,1,MAXR,MAXR,MAXR)
   CALL NPNRMX (VECTOR(K2), H(K2), N, EIGVAL(K3), INDEX, MAXR, NC,1)
   INDEX=0
   CALL MMULTD (A,NC-1,H(K2),NC-1,VECTOR(K2),N,N,1,MAXR,MAXR,MAXR)
   CALL NPNRMX (VECTOR(K2), H(K2), N, EIGVAL(K3), INDEX, MAXR, NC,1)

TEST FOR SINGLE ROOT CONVERGENCE
DO 23 J=1,NC
   J1=(J-1)*MAXR
   K=K1+J1
   GOTO (24,19,21),NAK
23
24
19
   L=K5+J1
   DO 20 I=1,N
20

```

MATRIX ITERATION SUBROUTINE, REAL OR COMPLEX.

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```

L=L+1          HMO31785
K=K+1          HMO31786
IF ( ABSF(H(L))-H(K)) - EPSP ) 20,20,24
CONTINUE
20   GOTO 100
DO 22 I=1,N
K=K+1          HMO31788
IF ( ABSF(US(K))-H(K)) - EPSP ) 21,21,22
CONTINUE
22   GOTO 100
IF ACCUMULATOR OVERFLOW 108,102
100  IF DIVIDE CHECK 104,56
102  IF NP=3
104  NP=3
GOTO 109
C NO CONVERGENCE. SO TEST MAXIMUM NUMBER OF ITERATIONS.
24  IF ( NITER(MODE)-NITRSP ) 25,100,100
C NOT YET EXCEEDED, SO TRY FOR AITKENS TIME.
25  GOTO (40,44,31),NAK

C TEST FOR AITKENS CONVERGENCE.
31  GOTO (26,36),NC

26  DO 28 I=1,N
J=K5+I          HMO31800
K=K1+I          HMO31801
IF ( US(K)-H(J) ) 27,28,27
27  IF ( ABSF( H(K)-US(K) ) / (US(K)-H(J)) ) - AITKEN ) 28,28,32
28  CONTINUE

C ALL VECTOR ELEMENTS OK, SO APPLY AITKENS SPEEDER-UPPER.
DO 30 I=1,N
J=K5+I          HMO31802
K=K1+I          HMO31803
Q=(H(K)-2.*US(K)+H(J))
IF ( Q ) 29,30,29
30

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MATRIX ITERATION SUBROUTINE, REAL OR COMPLEX.

29 H(K)=H(J) - ( US(K)-H(J))**2 / Q)
30 CONTINUE
NAKSR(MODE)=NAKSRI(MODE) + 1
GOTO 17

C CONVERGENCE TEST NOT MET. RESTORE AND TRY AGAIN.

32 DO 33 J=1,NC
J1=MAXR*(J-1)
DO 33 I=1,N
J=K1+J1+I
K=K5+J1+I
H(K)=US(J)
33 US(J)=H(J)
NAK=2
GOTO 18

C IF PROBLEM COMPLEX, REPEAT ALL ABOVE FOR COMPLEX ARITHMETIC.

36 DO 38 I=1,N
J=K5+I
K=K1+I
JJ=J+MAXR
KK=K+MAXR
Q = (US(K)-H(J))**2 + (US(KK)-H(JJ))**2
IF ( Q ) 37,38,37
37 IF ( (H(K)-US(K))**2 + (H(KK) - US(KK))**2 ) / Q-AT) 38,36,32
H(K)=H(J)
38 CONTINUE
DO 39 I=1,N
J=K5+I
JJ=J+MAXR
K=K1+I
KK=K+MAXR
Q = (H(K)-2.*US(K)+H(J))**2 + (H(KK)-2.*US(KK)+H(JJ))**2
IF ( Q ) 35,39,35
35 X=H(K)
H(K)= H(J) - ( ((US(K)-H(J))**2 - (US(KK)-H(JJ))**2)*(H(K)-2.*
HH031823
HH031824
HH031825
HH031826
HH031827
HH031828
HH031829
HH031830
HH031831
HH031832
HH031833
HH031834
HH031835
HH031836
HH031837
HH031838
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HH031844
HH031845
HH031846
HH031847
HH031848
HH031849
HH031850
HH031851
HH031852
HH031853
HH031854
HH031855
HH031856
HH031857
HH031858
HH031859
HH031860

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MATRIX ITERATION SUBROUTINE, REAL OR COMPLEX.

```

1      US(K)+H(J)+(2.*US(K))-H(J)*(US(K)-H(JJ))*  
      (H(KK)-2.*US(KK)+H(JJ)) / Q   HMO31861  

2      H(KK)=H(JJ)-((L-2.*US(K)-H(LJ))*(US(KK)-H(JJ)))*  
      (US(K)+H(J)-H(LJ)*2-(US(K)-H(JJ))**2) / Q   HMO31862  

1      H(KK)=H(JJ)-((L-2.*US(K)-H(LJ))*2-(US(K)-H(JJ))**2) / Q   HMO31863  

2      * (H(KK)-2.*US(KK)+H(JJ)) / Q   HMO31864  

HMO31865  

HMO31866  

HMO31867  

HMO31868  

HMO31869  

HMO31870  

HMO31871  

HMO31872  

HMO31873  

HMO31874  

HMO31875  

HMO31876  

HMO31877  

HMO31878  

HMO31879  

HMO31880  

HMO31881  

HMO31882  

HMO31883  

HMO31884  

HMO31885  

HMO31886  

HMO31887  

HMO31888  

HMO31889  

HMO31890  

HMO31891  

HMO31892  

HMO31893  

HMO31894  

HMO31895  

HMO31896  

HMO31897  

HMO31898

```

39 CONTINUE
NAKSRI(MODE) = NAKSRT(MODE) + 1
GOTO 17

40 DO 41 J=1,NC
J1=MAXR*(J-1)
DO 41 I=1,N
K=K1+J1+I
L=K5+J1+I
41 H(L)=H(K)
41 GOTO 118,56),IGO

44 DO 45 J=1,NC
J1=MAXR*(J-1)
DO 45 I=1,N
K=K1+J1+I
45 US(K)=H(K)
45 GOTO 18

56 DO 58 J=1,NC
J1=MAXR*(J-1)+INDEX
DO 58 I=1,N
K=K1+MAXR*(J-1)+I
US(K)=A(JA,
J1=J1+K4
58 CALL SWEEX (VECTOR,A,H,US,EIGVAL,MODE,N,MR,NC,INDEX,EPPSP)
IF ACCUMULATOR OVERFLOW 108,106
106 IF DIVIDE CHECK 107,59
107 IF (NTAPE1) 119,118,119
116 IR=MODE
GOTO 120

MATRIX ITERATION SUBROUTINE, REAL OR COMPLEX.

```

119 WRITE OUTPUT TAPE NTAPE1, 131, 800LT(3),800LT(4)
      WRITE OUTPUT TAPE NTAPE1, 134, MODE
120 DO 125 I=1,NC
      K=K1+MAXR*(I-1)
      DO 125 J=1,N
      K=K+1
      VECTOR(K)=0.
59   J1=(NC-1)*MAXR+INDEX
      GUESS(J1)=0.
      GUESS(INDEX)=0.

62 IF (NMODE-MODE) 70,70,15
108 NM=1
109 IR=MODE
      IF (I NTAPE1) 121, 70,121
121 WRITE OUTPUT TAPE NTAPE1, 131, 800LT(NP) ,800LT(NP+1)
      MODE=MODE-1
      WRITE OUTPUT TAPE NTAPE1, 132, MODE
70 IF (I NTAPE ) 71,75,71
71 DO 73 J=1,N
73 READ TAPE NTAPE, (A(I),I=J,J2,MAXR)
      CALL MMULTD (A,NC-1,VECTOR,NC-1,US,N,N,MODE ,MAXR,MAXR,MAXR)
      J=1
      K=1
      CO 72 I=1,MODE
      INDEX=0
      CALL NPNRMX (US(J),US(J),N,H(K),INDEX,MAXR,NC,1)
72 K=K+NC
75 IF ( NTAPE1 ) 92,92,80

80 WRITE OUTPUT TAPE NTAPE1, 95
      DO 86 I=1,MODE
      IF ( NITER(I)-NITRSP ) 85,87,87

```

MATRIX ITERATION SUBROUTINE, REAL OR COMPLEX.

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```

87 WRITE OUTPUT TAPE NTAPE1, 94, I HMO31937
85 GOTO 183,84),NC HMO31938
83 WRITE OUTPUT TAPE NTAPE1, 97, (I,EIGVAL(I), NITER(I), NAKSR(I)) HMO31939
82 GOTO 86 HMO31940
84 L=2*I-1 HMO31941
     WRITE OUTPUT TAPE NTAPE1, 96, (I,EIGVAL(I),EIGVAL(I+1),NITER(I), NAKSR(I)) HMO31942
1 HMO31943
86 CONTINUE HMO31944
   IF ( I MODE ) 92,92,88 HMO31945
88 WRITE OUTPUT TAPE NTAPE1, 98 HMO31946
   L=MODE*NC HMO31947
CALL MPKINT (VECTOR,N,L,MAXR,NTAPE1) HMO31948
   IF ( I NTAPE ) 92,92,90 HMO31949
90 WRITE OUTPUT TAPE NTAPE1, 99 HMO31950
   WRITE OUTPUT TAPE NTAPE1, 93, (H(I),I=1,L) HMO31951
   CALL MPRINT (US,N,L,MAXR,NTAPE1) HMO31952
92 RETURN HMO31953
93 FORMAT 1 1H 6E16.8 ) HMO31954
94 FORMAT (5H MODE 114, 40H HAS NOT CONVERGED IN MAXIMUM ITERATIONS HMO31955
95 FORMAT 11H 5X, 6H MODE 13X, 11H EIGENVALUE 19X, HMO31956
1 11H ITERATIONS 6X, 9H AITKENS // / / HMO31957
96 FORMAT (1H 1111, 2E19.8, 119, 119 ) HMO31958
97 FORMAT (1H 1111, 9X, 1E20.8, 9X, 119, 119 ) HMO31959
98 FORMAT (1HO // 1HO 46X, 14H EIGENVECTORS // ) HMO31960
99 FORMAT (1HO // 1HO 36H CHECK EIGENVALUES AND EIGENVECTORS ) HMO31961
131 FORMAT (135H1ERROR IN ITERATION SUBROUTINE... ( 2A6, 1H ) HMO31962
132 FORMAT (25H+ CALCULATION TERMINATED. 116,19H MODES ARE CORRECT.) HMO31963
134 FORMAT (14H+ IN TRUE MODE 116, 27H CALCULATION. MODIFIED MODE HMO31964
1 HMO31965
1 12H IS CORRECT.
1 END(1,0,0,G,0,0,0,0,1,0,0,0,0,0,0,0,0)

```

MATRIX ITERATION SUBROUTINE, REAL OR COMPLEX.

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STORAGE NOT USED BY PROGRAM

	DEC	OCT		DEC	OCT
1795	03403			32561	77461

STORAGE LOCATIONS FOR VARIABLES APPEARING IN DIMENSION AND EQUIVALENCE STATEMENTS

	DEC	OCT		DEC	OCT		DEC	OCT
BONU1	1794	03402						

STORAGE LOCATIONS FOR VARIABLES NOT APPEARING IN COMMON, DIMENSION, OR EQUIVALENCE STATEMENTS

	DEC	OCT		DEC	OCT		DEC	OCT		DEC	OCT
AT	1790	03376		1G0	1789	03375	INDEX	1788	03374		
J1	1786	03372		J2	1785	03371	JJ	1784	03370	J	1783 03367
K1	1782	03366		K2	1781	03365	K3	1780	03364	K4	1779 03363
K5	1778	03362		K6	1777	03361	KK	1776	03360	K	1775 03357
L	1774	03356		MODE	1773	03355	NAK	1772	03354	NP	1771 03353
Q	1770	03352	X	1769	03351						

SYMBOLS AND LOCATIONS FOR SOURCE PROGRAM FORMAT STATEMENTS

	EFN	LOC		EFN	LOC		EFN	LOC		EFN	LOC
8)2T	93	03301		8)2U	94	03276	8)2V	95	03264	8)30	96 03240
8)31	97	03232		8)32	98	03223	8)33	99	03213	8)43	131 03201
8)44	132	03167		8)46	134	03155					

LOCATIONS FOR OTHER SYMBOLS NOT APPEARING IN SOURCE PROGRAM

	DEC	OCT		DEC	OCT		DEC	OCT		DEC	OCT
IJ	1732	03304	2)	1612	03114	3)	1616	03120	4)	32767	77777
G1	1625	03131	9)	1730	03302	C1G1	1742	03316	C1G2	1743	03317
C1G3	1744	03320	C1G4	1745	03321	C1G5	1746	03322	C1G6	1747	03323
C1G7	1748	03324	C1G8	1749	03325	C1G9	1750	03326	C1GA	1751	03327
C1GB	1752	03330	C1GC	1753	03331	C1GD	1754	03332	C1GE	1755	03333
C1GF	1756	03334	C1203	1757	03335	C1204	1758	03336	C1205	1759	03337
C1206	1760	03340	C1207	1761	03341	C1208	1762	03342	C120A	1763	03343
C120B	1764	03344	C120D	1765	03345	C120F	1766	03346	C120H	1767	03347

MATRIX ITERATION SUBROUTINE. REAL OR COMPLEX.

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C)20L	1768	03350	D)10Q	543	01037	D)118	705	C)1301	D)11H	718	01316
D)11D	727	01327	D)11N	812	01454	D)131	1364	02524	D)139	1463	02667
D)20L	501	00765	D)20P	538	01032	D)20V	658	01222	D)21J	772	01404
D)21V	927	01637	D)22B	1138	02162	D)22T	1304	02430	D)237	1418	02612
D)318	704	01300	D)31V	926	01636	D)32B	1137	02161	D)337	1417	02611
D)339	1462	02666	D)40K	446	00676	D)40R	612	01144	D)410	823	01467
D)422	982	01726	D)423	1072	02060	D)426	1090	02102	D)42F	1169	02221
D)426	1176	02230	D)42U	1325	02455	D)438	1480	02710	D)43M	1607	03107
D)510	717	01315	D)510	822	01466	D)522	981	01725	D)523	1071	02057
C)531	1363	02523	D)626	1089	02101	D)62F	1168	02220	D)62U	1324	02454
D)638	1479	02707	D)63M	1606	03106	D)718	703	01277	D)731	1362	02522
D)739	1461	02665	E)V	655	01217	E)11	667	01233	E)14	688	01260
E)16	698	01272	E)1H	758	01366	E)11	764	C)1374	E)1L	8C0	01440
E)1M	805	01454	E)2J	1217	02301	E)3D	1497	02731	E)3E	15C1	02735
E)11N	814	01456									

LOCATIONS OF NAMES IN TRANSFER VECTOR

MMULTD	DEC	OCT		DEC	OCT		DEC	OCT		DEC	OCT
(MMULTD (FILE) (STH))	5	00005	MPRINT (RLR) (TSB)	10	00012	NPNRMX (RWT) (WLR)	6	00006	SWEEX (STH)	7	00007
	9	00011		2	00002		0	00000		3	00003
	8	0C010		1	00001		4	00004			

ENTRY POINTS TO SUBROUTINES NOT OUTPUT FROM LIBRARY

MMULTD (STH)	MPRINT (TSB)	NPNRMX (WLR)	SWEEX (RWT)	FIL	(RLR)	(RWT)	(STB)
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EXTERNAL FORMULA NUMBERS WITH CORRESPONDING INTERNAL FORMULA NUMBERS AND OCTAL LOCATIONS

EFN	IFN	LOC									
3	20	00501	4	21	00503	5	24	00517	1	27	00532
6	34	00560	2	36	00571	7	41	00614	8	42	00620
9	46	00635	12	47	00637	13	48	00643	14	52	00670
15	53	00677	16	68	00117	17	69	01033	18	70	01040
19	81	01170	20	86	01231	21	88	01242	22	91	01270
23	92	01273	100	93	01302	102	95	01305	104	96	01310

MATRIX ITERATION SUBROUTINE, REAL OR COMPLEX.

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24	98	01317	25	99	01323	31	100	01330	26	101	01332
27	105	01352	28	106	01371	29	112	01425	30	113	01442
32	116	01460	33	122	01524	36	125	01542	37	132	01614
38	133	01640	35	141	01727	39	144	02061	40	147	02073
41	152	02135	44	154	02153	45	158	02207	56	160	02222
58	165	02265	106	170	02331	107	171	02334	118	172	02340
119	174	02343	120	178	02371	125	182	02420	59	183	02431
62	186	02447	108	187	02456	109	188	02462	121	190	02466
70	195	02525	71	196	02527	73	197	02534	72	211	02654
75	212	02670	80	213	02674	87	216	02716	85	218	02733
83	219	02737	84	223	02760	86	227	03010	88	229	03017
90	234	03050	92	242	03110						

SINGLE OR DOUBLE PRECISION, REAL OR COMPLEX VECTOR NORMALIZATION.

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```

C CALL NPNRMX(IA, B, N, FL, INDEX, MC, NX, NP )
C   A=VECTOR TC BE NORMALIZED      B=NORMALIZED VECTOR(MAY=A)H031948
C   N=SIZE                           B=NORMALIZED NUMBER           H031950
C   INDEX++  CN ENTRY, NORMALIZE ON NUMBER WHOSE INDEX IS INDEX    H031951
C   =0 ON ENTRY, NORMALIZE ON LARGEST S.H. AND SET INDEX=TC ITS INDEX. H031952
C   INDEX=TC
C   -- CN ENTRY, NORMALIZE ON FL.                                     H031953
C   MC=SINGLE PRECISION DIMENSIONED NUMBER OF ROWS CF A AND B     H031954
C   NX=1, VECTOR REAL          H031955
C   =2, VECTOR COMPLEX         H031956
C   NP=1, SINGLE PRECISION    H031957
C   =2, DOUBLE PRECISION      H031958
C
C SUBROUTINE NPNRMX (A, B, N, FL, INDEX, MC, NX, NP )
C
D  DIMENSION A(1), B(1), FL(1), D(1), C(1)
C
A1=1+NP
A2=N+NP
N4=MC*NP
IF ( INDEX ) 32, 7, 38
7 GOTO (11,8),NX
8 FL= (A(1)**2+A(N4+1)**2)
INDEX=1
CO 10 K=N1,N2,NP
I=K+I4
C= (A(K)**2+A(I1)**2)
IF ( FL-C ) 5,5,1C
9 FL=D
INDEX=K
10 CCNTINUE
6 FL=A(INCEX)
GOTO (18,25),NP
11 FL=ABSF(A(1))
INCEX=1
EO 13 K=N1,N2,NP

```

SINGLE CR DOUBLE PRECISION, REAL CR COMPLEX VECTOR NORMALIZATION.

```

C=ABSFL(A(K))
  IF  (FL-C)    12,12,13
12   FL=C
      INCEX=K
      CONTINUE
13
14   FL=A(INCEX)
      GCIC (16,21),NP
16   CC 17  I=1,N
17   B(I)=A(I)/FL
      GOTO 3,
18   I=INCEX+*C
      FL(2)=A(I)
19   C=FL(1)*2+FL(2)**2
      CG 20  I=1,N
      K=I+*C
      C=A(I)*FL(2)-A(K)*FL(1)
      B(I)=(A(I)*FL(1)+A(K)*FL(2))/D
20   E(K)=-C/D
      GOTO 3,
21   FL(2)=A(INDEX+1)
23   CO 24  I=1,N2,NP
C 24   B(I)=A(I)/FL
      GOTO 28
25   FL(2)=A(INDEX+1)
      I=INCEX+N4
      FL(3)=A(I)
C 26   C=FL(1)*2+FL(2)**2
      CO 27  I=1,N2,NP
      K=I+N4
      C=A(I)*FL(3)-A(K)*FL(1)
      B(I)=(A(I)*FL(1)+A(K)*FL(3))/D
C 27   E(K)=-C/D
      INCEX=INCEX/2+1

```

SINGLE OR DOUBLE PRECISION. REAL OR COMPLEX VECTOR NORMALIZATION.

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```
30 RETURN
32 GCTC (34,36), NX
34 GCTC (16,23), NP
36 GCTG (19,26), NP
38 GCTC (4C,35), AP
39 INCEX=2*INDEX-1
40 GCTU (14,6), NX
ENC(1,C,C,N,0,C,C,C,1,C,C,C,J,C)
```

SINGLE CR DOUBLE PRECISION, REAL CR COMPLEX VECTOR NORMALIZATION.

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STORAGE NOT USED BY PROGRAM

	DEC	OCT	CCT
590	01116	32561	77461

STORAGE LOCATIONS FOR VARIABLES APPEARING IN DIMENSION AND EQUIVALENCE STATEMENTS

	DEC	OCT	CCT	DEC	OCT	DEC	OCT
C	587	01113		0	589	01115	

STORAGE LOCATIONS FOR VARIABLES NOT APPEARING IN COMMON, DIMENSION, OR EQUIVALENCE STATEMENTS

	DEC	OCT	CCT	DEC	CCT	DEC	OCT
I	585	01111		K	584	01110	
N4	581	01105		N1	583	01107	

LOCATIONS FOR OTHER SYMBOLS NOT APPEARING IN SOURCE PROGRAM

	DEC	CCT	DEC	CCT	DEC	CCT	DEC	OCT
1	571	01073	2	560	01060	4	32767	77777
91	568	01070	C1G0	575	01077	C1G2	576	01100
C1G4	578	011C2	C1G5	579	01103	C1G6	580	011C4
C1I07	251	0C373	D1I3D	267	CC437	D1I0E	295	00447
C1I09	357	00545	C1I6L	531	01023	C1214	556	01054
D1607	248	00370	E12	260	0C310	E15	243	00363
E1V	526	01C30	E112	545	01041	E10E	292	00444

LOCATIONS OF NAMES IN TRANSFER VECTOR

	DEC	OCT	DEC	CCT	DEC	CCT	DEC	OCT	
DEXPL2	1	00001	(DFAC)	2	00002	(CFDP)	C	0000C	
(CFSB)	4	00004					(CFNP)	3	000C3

ENTRY POINTS TO SUBROUTINES NOT OUTPUT FROM LIBRARY

SINGLE OR DOUBLE PRECISION. REAL OR COMPLEX VECTOR NORMALIZATION.

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EXTERNAL FORMULA NUMBERS WITH CORRESPONDING INTERNAL FORMULA NUMBERS AND OCTAL LOCATIONS											
(CFAC)			(CFDP)			(OFMP)			(OFSB)		
EFN	IFN	LCC	EFN	IFN	LOC	EFN	IFN	LCC	EFN	IFN	LOC
7	8	C03U5	8	9	0C311	9	15	C0354	1C	17	00364
6	18	C0374	11	20	0C4C1	12	25	00425	13	27	00433
14	28	C0440	16	30	00450	17	31	00453	18	32	00461
15	25	C0471	20	40	00531	21	42	00542	22	43	00546
24	44	C0553	25	46	00574	26	49	00612	27	54	00760
26	55	C1011	3C	56	01024	32	58	01031	34	59	01033
36	6C	01C36	38	61	01042	39	62	01045	4C	63	01055

11/F 2/62

```

SUBROUTINE DIVERG
      DIMENSION NCP(124), C(1C), X(5C), Y(5C), ATT1(5C,2), CZRE(50,2),
     1        FACC(5C,2), LL(5C), LH(5C), CAIN(5C,2), LR(50,2),
     2        NCPT(5C), DELY(5C), ZI(50,1),
     3        DIMENSION A(5C,5C), B(5C,5C), C(5C,50), G(50),
     4        NITER(5C)
     5
     EQUIVALENCE (NOP(14),AC), (NOP(13),NEST1), (LM,X), (LL,Y),
     1        (NOP(17),ARC), (NOP(4),APCDE), (NOP(23),TITL),
     2        (NOP(24),TITL2)
     CUMPCN NOP,X,Y,NTAPE2,NTAPE3,NTAPE4,NTAPE5,NTAPE6,NTAPE8,CHAR,
     1        FLEXK,CAPS,CAPL,CAPT,CAPN,SMALS,CAPXC,CAPZ,CAPHC,C,
     2        MAXR,ATT1,CZRE,CAIN,HR,HADD,NSTRF,ACPT,DELY,ZI,MAXC,AC,
     3        NCNRC,A,B,C,G,EIGVAL,NITER,DIVC,EP,IR,I
     4
     600 FORMAT (1H1 38X, 17-DIVERGENCE OPTION // 1HC 16X, 4HMCDE 1CX,C 14HNO. ITERATIONS // )
     1        6HLAGMDA 11X, 11HDIVERGENI Q 7X, 14HNO. ITERATIONS // )
     601 FORMAT (1H 111, 1119, 2E2C.8, 1113),
     602 FORMAT (1H 43X, 26HIMAGINARY RESULT FROM MCDE 114 )
     603 FORMAT (1H 22X, 4CHIN SUFFICIENT CONVERGENCE AFTER 206 ITERA
     1        TIONS, MCCE 114 )
     604 FORMAT (1H0 37X, 4CHMEDIAL CCUMPS NORMALIZED ON THE LARGEST
     1        ELEMENT )
     605 FORMAT (48H0 AN OVERFLOW OCCURRED IN THE EIGENVALUE ROUTINE.
     1        1116, 19- MODES ARE CORRECT.)
     606 FORMAT (1H0 25X, 36H CHECK EIGENVALUES AND EIGENVECTRS )

      WRITE CPUTPUT TAPE NTAPE3, 6CC
      REWIND NTAPE4
      REWIND NTAPES

      C READ FLEXIBILITY MATRIX INIT CORE AT C, AND AERODYNAMIC MATRIX AT B
      READ TAPE NTAPE4, ((C(I,J),J=1,NRC),I=1,NRC)
      READ TAPE NTAPES, ((R(I,J),J=1,NRC),I=1,NRC)
      CALL MMULTC (C,C,B,J,A,NRC,ARC,NRC,MAXR,MAXR,MAXR)

```

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```
C SET UP GLESS EIGENVECTOR FOR ITERATION.  
CG, E1C I=1,NRC  
610 G(I)=I  
  
EP=.2E-65  
CALL MITER (A,NTAPEE,ARC,G,1,NMCD,8,EIGVAL,NITER,200,EP,IR,C,  
1 C(1,26),MAXR,1,938C832,LL,C)  
1 IF ( IR ) 611,612,611  
611 IR=IR-1  
WRITE CPUTPUT TAPE NTAPE3, 605, IR  
NMCC=IR  
  
612 EO 616 I=1,NPCE  
CIVQ=CBAR/(EIGVAL(I)*FLEXK*CAPS)  
IF (EIGVAL(I)) 613,613,614  
613 WRITE CPUTPUT TAPE NTAPE3, 6C2, 1  
614 IF ( NITER(I)-199) 616,616,615  
  
615 WRITE CPUTPUT TAPE NTAPE3, 6C3, 1, EIGVAL(I), DIVQ, NITER(I)  
616 WRITE CPUTPUT TAPE NTAPE3, 601, 1, EIGVAL(I), DIVQ, NITER(I)  
  
WRITE CPUTPUT TAPE NTAPE3, 604  
CALL MPRINT (B,NRC,NMCD,MAXR,NTAPE3)  
WRITE CPUTPUT TAPE NTAPE3, 606  
CALL MPRINT (C(1,26),NMCD,1,MAXR,NTAPE3)  
CALL MPRINT (C,NRC,NMCD,MAXR,NTAPE3)  
  
RETURN  
END(1,C,C,I,O,C,C,O,C,L,R)
```

HM032102

DATA

Aerospace Corporation, El Segundo, California. QUASI-STATIC AERO-THERMO-ELASTIC ANALYSIS: ANALYTICAL DEVELOPMENT AND COMPUTATIONAL PROCEDURE, prepared by W. P. Rodden, E. F. Farkas, and H. A. Malcolm. 1 March 1963. [172] p. incl. illus. (Report TDR-169(3230-11)TN-8; SSD-TDR-63-14) (Contract AF 04(695)-169). Unclassified report A collocation formulation is used as the basis for a unified approach to the various quasi-static aero-thermo-elastic problems. These problems include rigid and flexible load distribution, divergence, estimation of rigid and flexible static and dynamic stability derivatives, and the correction of wind tunnel data measured on flexible models. The formulation utilizes structural, thermal, and aero-dynamic influence coefficients. The Aerospace IBM 7090 Computer Program No. LD003A provides the solution to the above problems. The program (over)	UNCLASSIFIED	UNCLASSIFIED
Aerospace Corporation, El Segundo, California. QUASI-STATIC AERO-THERMO-ELASTIC ANALYSIS: ANALYTICAL DEVELOPMENT AND COMPUTATIONAL PROCEDURE, prepared by W. P. Rodden, E. F. Farkas, and H. A. Malcolm. 1 March 1963. [172] p. incl. illus. (Report TDR-169(3230-11)TN-8; SSD-TDR-63-14) (Contract AF 04(695)-169). Unclassified report A collocation formulation is used as the basis for a unified approach to the various quasi-static aero-thermo-elastic problems. These problems include rigid and flexible load distributions, divergence, estimation of rigid and flexible static and dynamic stability derivatives, and the correction of wind tunnel data measured on flexible models. The formulation utilizes structural, thermal, and aero-dynamic influence coefficients. The Aerospace IBM 7090 Computer Program No. LD003A provides the solution to the above problems. The program (over)	UNCLASSIFIED	UNCLASSIFIED

UNCLASSIFIED

capacity is fifty collocation control points and ten
values of dynamic pressure.

UNCLASSIFIED

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